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LABOR COSTS IN ELECTRIC-POWER PRODUCTION.

One of the chief sources of economy in power production on a large scale is the tendency of labor cost per unit of output to decrease as the total volume of energy delivered at the busbar rises and as the load-factor grows greater. Comparing generating plants of the same type, one finds that the wages cost per kilowatt-hour is reduced more and more as the output of the station is forced to large figures. To a lesser extent the fuel cost per unit delivered at the switchboard illustrates the benefits of a large production. As the load upon a given generating unit increases the tendency is for the equipment to show higher efficiency, and even when equipment is heavily overloaded there is seldom any serious loss in efficiency, so long as reliable service is maintained. But when all is said and done, the fact remains that the actual fuel consumption, in total pounds per hour burned under the boilers, inevitably increases with any large increase in output, while the labor cost may remain constant through a much larger range of production. In homely terms, it takes about as many men to run the average station when the load is half the maximum as when it is at three-quarters and not seldom does one find that the same labor requirements are in evidence on each of the daily shifts, regardless of the wide variations exhibited in the demand upon the plant as a whole.

Other things being equal, the use of large generating units and a simple, clean-cut and straightforward station design results in a lower cost of production than in a smaller plant where the units are many and of very limited individual capacity. The difference may be as high as three or four-tenths of a cent per kilowatt-hour between a plant rated at 5,000 or 6,000 kilowatts, and one with a normal capacity of 700 or 800 kilowatts, assuming that both installations are operated with due regard to the benefits of long-hour business. In a number of stations of generally similar types examined it was found that a 6,000-kilowatt plant required the services of twenty-two men for its daily operations, while a 630-kilowatt station utilized the services of six men. Little could be done to cut down the labor cost of the smaller station except to endeavor to secure a large volume of long-hour business. The use of small machines in this station and the necessity of operating with at least six employees, two of whom worked on each shift, pre-

cluded any higher efficiency of labor than is expressed by a cost of attendance of about seven-tenths of a cent per kilowatt-hour. The larger station, with its more favorable conditions, and particularly its higher-capacity generating units, produced electricity with an attendance cost of about three-tenths of a cent per unit, and the annual station wages per kilowatt of station capacity were determined to be $4.31 in the case of the larger plant and $7.95 in the smaller installation. In the smaller plant the average generating capacity which each employee looked after was 105 kilowatts, and in the larger station, 272 kilowatts. In most power plants of moderate size depending upon steam machinery for their service it has been found most difficult to carry the cost of attendance per kilowatt-hour down below one-fourth of a cent, but the tendency is in that direction as the new business departments of lighting and power companies add profitable loads to the system. In great stations like those in service on systems supplying urban demands from generating units of 10,000 or 15,000 kilowatts individual capacity the possibilities of low attendance cost are most attractive. The smaller plant can enjoy some of these benefits if it strives to load its equipment heavily and in remodeling to select large units well spaced about the engine room instead of continuing operations with equipment of multiplied moving parts and very limited capacity.

WIRELESS IN WINTER.

An important step in utilizing wireless as an aid to the preservation of life and property was recently taken when the Canadian Government decided to keep its wireless stations on the Magdalen Islands open all through the winter and also to install new stations at Point Armour and Belle Isle. The Magdalens lie almost in the middle of the Gulf of St. Lawrence.

In the past, communication has at times been entirely cut off, as was the case last winter, by the breaking of the submarine cable, which runs to that island. At any time during a fierce northern storm such a break is liable to occur, and when this does happen, communication can not of course be re-established until the following summer. The wireless apparatus is undoubtedly subject to accident as well as is the submarine cable, but where the submarine cable lies under a great field of ice, there is but little comparison as to the ease of repair.

While of especial advantage to the islanders themselves, the real value of the winter wireless service lies in the fact that vessels may be warned of the ice conditions in the vicinity of the islands. This applies not only to the ocean liners which pass the Grand Banks, but to the fleets of fishing vessels which every spring leave Newfoundland and New England points for these waters. The action of the Canadian Government is one which will contribute much to the safety of hundreds of lives and a great amount of property.

STREET RAILWAYS AND TOWN DEVELOPMENT.

The street and interurban railways have materially influenced the development of villages into towns and indeed have frequently caused the foundation of townships where none had previously existed. Another effect has been the moving out of the congested city population toward the suburbs and the locating of the business areas into well defined centers forming the converging points of the various street-railway systems.

But the opportunities for urban and suburban improvements made possible by these developments do not seem to have been exploited in any but the most haphazard manner. America has done a great deal toward developing the street-railway business, but one must turn to Europe to observe the refinements of progressive civilization in the working out of the problems of residential districts and adequate transportation facilities. Germany has set the pace for the rest of the world in this movement and England is proving a worthy follower and an originator of ideas also in this connection.

At the recent convention of the Municipal Tramways Association in Great Britain, Mr. A. Baker, general manager of the Birmingham Corporation Tramways, read a suggestive paper entitled "Tramways in Relation to Town Planning," in which he advocated much wider roads, with portions set apart for the exclusive use of street railways. These, he said, being unhampered by ordinary vehicular traffic, could then be operated at much higher speeds than are possible under prevailing conditions, with the result that a larger residential area would be available for suburbanites working in the business section of the city. He cited the case of Berlin where such roads are used, the street-railway tracks being filled in between the ties with green turf, and the widened roads transformed into boulevards. A cheaper method of construction is also made possible by this means, thus enabling the street railways to be extended into districts where the traffic is so light that under the old conditions the track construction would make the cost of installation prohibitive.

At the same meeting, Mr. P. Fisher, of Dundee, mooted the idea that trackless trolleys could be used to exploit new districts, a permanent track to be afterwards laid when the traffic justified it, and the overhead equipment retained for use with the rails.

It appears that in Birmingham the authorities are successfully developing a scheme similar to that outlined above. In the United States it might at least be tried in the case of a new town, for in this growing country a new industry will develop a flourishing town almost over night.

as instanced by the remarkable steel town of Gary, Ind., which but a short time ago was a rolling waste of sand dunes. In the environments of such towns as Chicago there are plenty of opportunities for developing new residential districts. Whether the initiative be taken by the street-railway companies, or the real-estate men, or the city itself, it is not for us to say, but at any rate it seems to be worth somebody's while to try it.

HELPING OUT THE ISOLATED PLANT.

Most central stations are engaged in a continual campaign to win over the isolated plants in their territory to the use of central-station service. Such customers, if secured, are usually large customers, and are desirable therefore both on account of the immediate business represented and because they help to reduce the unit cost of production. Consequently it is customary to offer inducements to such prospective customers which will win them over, even though it is necessary to offer contracts which leave little immediate profit to the central station. This is considered justifiable on the grounds mentioned above and, as a purely business proposition, is usually desirable to the station. But with regulation of rates by public-service commissions coming into vogue, with accompanying regulations preventing discrimination between customers, such special contracts may of necessity become things of the past.

The endeavor to secure such isolated-plant business has sometimes engendered in the breast of the central-station manager an antagonism which leads to a spirit of unwillingness to do anything which may help the isolated plant. This help may be sought under a variety of circumstances. There may be a breakdown which cripples the generating power of the isolated plant. The connected load of the plant may exceed its capacity, and there may be occasional times of short duration when it would be unsafe to overload the generating units to the point of supplying the demand. This may even become a permanent condition under circumstances such that the owner of the isolated plant does not care to enlarge and does not care to shut down his plant completely Again, he may have an unsafe overload which will be a regular demand under some temporary conditions, but would not justify a permanent enlargement of plant.

A policy of refusing service under such conditions, or offering it only under such terms as would be prohibitive, is a mistaken policy. A public-service company should stand ready to serve all applicants, and should meet demands for partial service with readiness and cordiality. Such a position not only betters the standing of the company in the eyes of the general public, but is a first step in securing the confidence and friendliness of the new customer which may eventually result in securing his entire load. Nothing is more convincing to the man who is debating whether to shut down his isolated plant, than to find that he can at all times secure power only limited by the capacity of his mains. If the central station demonstrates that it can furnish more satisfactory service than the owner's plant, it will have accomplished a great deal.

THE ELECTRICAL INDUSTRY IN ENGLAND AND AMERICA.

In the course of an address given before the Manchester, England, section of the Institution of Electrical Engineers, Mr. J. S. Peck, chairman of that body, gave some reasons why America had excelled England in electrical matters. As Mr. Peck had just returned to England after a trip to this country he was particularly well fitted to give an opinion on the subject, and at least three of the points upon which he dwelt are worthy of a brief consideration.

In the first place, he stated, municipal control does not exist here to such a degree as in England, and when a party of men enter upon an important development work they feel that any profit which may accrue will go to them; a fact which at least adds some incentive to the project.

The superior technical education given to the students in our engineering schools was another reason given, although as far as pure technics are concerned many hold the English schools to be superior to our own. There seems, however, to be but little doubt of the superiority of the American method of starting the technical graduate in the shop on the testing floor and letting him work out his own salvation. One has only to look over the list of men in the apprenticeship courses to see that technical graduates of all countries are realizing this fact as well as we do ourselves. It is in our factories that the graduate learns the relation of theory to industry; and a knowledge of this relation is necessary as a firm basis for industrial progress.

Finally the greater daring of the American business man, and his willingness to advance money for untried, but plausible projects has contributed much to our progress. So keen is this interest in new ventures that bond issues of new companies are frequently oversubscribed. We experience but little of the difficulty in raising money, which is met by our English cousins.

PROFESSORS OF ELECTRICAL ENGINEERING.

Upon another page of this issue will be found a list of technical schools and colleges offering courses in electrical engineering, with the name of the professor or instructor conducting the course. It is believed that such a compilation will be valuable for reference, and every effort has been made to make it complete and accurate to date. It is quite possible, however, that there have been omissions or errors in the names, and the editors will welcome any corrections or additions to the list. If it is found desirable to do so, the list will be published again in a future issue, with corrections. The order followed is geographical.

New York Section, Illuminating Engineering Society.

The custom of reviewing the Society's convention papers was continued at the November meeting of the New York Section of the Illuminating Engineering Society held at the United Engineering Societies' Building on the evening of November 10.

Dr. A. H. Elliott, chairman, called upon the local secretary, A. J. Marshall, who gave a brief résumé of the convention and lecture course at Johns Hopkins University, Baltimore, Md.

After this there was a general discussion, the first speaker being Dr. A. S. McAllister, who stated that one of the encouraging features of the convention was the quality of the gas papers presented. H. Thurston Owens called attention to the very practical methods suggested by the various lecturers; from their remarks both theory and practice were necessary to a larger extent than is sometimes granted. As an instance, Mr. Macbeth had suggested measuring an installation in part before completing, and Dr. Bell had suggested the almost ancient criterion for a minimum value of illumination in prominent open squares, viz., the ability to read a timetable at the darkest point in the square.

E. N. Hyde spoke in high praise of the various experiments which were part of the lectures. Mr. Hyde seemed to think that as only seven colleges were represented at the lecture course, there was a profitable field for both the Society and the colleges.

Dr. Elliott stated that those who attended the lectures were surprised at the breadth of the subjects. He paid tribute to the late Thomas Rowland, of Johns Hopkins, whose remains lie in a vault close to his wonderful dividing machine. He also said that it was becoming more and more apparent that the so-called practical man must look to the theorist for more and more aid every year and even every day.

Prof. G. S. Macomber, of Cornell University, outlined the work to be given to the seniors during the coming year which would at least fit them to specialize later in illuminating engineering should they desire to do so.

The following papers will be presented at the future New York Section meetings: December 8—"History of Photometric Standards," by Prof. E. L. Nichols, of Cornell. "Lighting of the Allegheny County Soldiers' Memorial Building, Pittsburg, Pa.," by Bassett Jones, Jr. January 12, 1911—"Physiology," by Dr. P. W. Cobb, of Cleveland, O. "Ultra-violet Rays," by Dr. Nelson M. Black, of Milwaukee, Wis. "Reflection Co-efficients," by Paul Bauder, of Cleveland, O. February 9—"Study of Reflecting and Diffusing Media," by Bassett Jones, Jr.

Society for the Promotion of Industrial Education.

The fourth annual convention of the National Society for the Promotion of Industrial Education is being held this week in Boston. The convention opened on November 17, the first day being devoted to the needs of young women. In the evening a banquet was tendered by the Boston Chamber of Commerce, the list of speakers including Frederick A. Delano, president of the Wabash Railroad; Frederick P. Fish, chairman of the Massachusetts Board of Education, and Commissioner of Labor Charles P. Neill.

At the morning session on November 18 M. W. Alexander, of the General Electric Company, presided, and the topic "Apprenticeship and Corporation Schools" was discussed by Tracy Lyon, of the Westinghouse Electric and Manufacturing Company, F. W. Thomas, Samuel F. Hubbard and others.

St. Louis Section of the American Institute of Electrical Engineers.

A meeting of the St. Louis Section of the American Institute of Electrical Engineers was held on Wednesday, November 9, at the electrical laboratory of Washington University.

The papers read were "Transformer Iron Losses," by G. A. Waters, and "Induction Motor Iron Losses," by F. J. Bollivant. Both papers were illustrated with lantern slides. An oscillograph demonstration by Prof. A. S. Langsdorf, of Washington University, followed the reading of the papers.

Underwriters' National Electric Association.

The announcement has been made that the biennial meeting of the Electrical Committee of the Underwriters' National Electric Association will be held in New York City, in March 1911. The day and place of meeting will be announced later.

As usual, the provisions of the National Electrical Code as they now exist will be the principal matter for consideration, and it is requested that any desired change in, or addition to, the Code, also all subcommittee reports be forwarded to C. M. Goddard, 141 Milk Street, Boston, by January 15, so that they may appear in the *Bulletin*.

Continental Telephone and Telegraph Suit.

On application of the National Exchange Bank, of Wheeling, W. Va., an order has been issued requiring the Continental Telephone and Telegraph Company to show cause why a receiver should not be appointed. A temporary order has been issued restraining the Company from doing business. The bank charges that the Company owes it a balance of $50,000 on a $100,000 promissory note. Extravagant management is also laid to the Company, and it is alleged that liabilities exceed assets by about $3,000,000.

National Municipal League.

At the sixteenth annual meeting of the National Municipal League and Conference for Good City Government, held in Buffalo, N. Y., this week, papers were presented by D. C. Jackson on "Is a Rational Basis Possible for Telephone Rates?" by Paul Leake on "The Detroit Street Railway Situation," and by Robert T. Payne on "The League's Franchise Policy."

Pittsfield Section Meeting.

At the meeting of the Pittsfield Section of the American Institute of Electrical Engineers on November 10, an address was given by D. McFarlan Moore on the development and application of the Moore light. The talk was supplementel by demonstration and lantern slides.

Tubes for Tunnel Nearing Completion.

Work on the big double-barreled tube of steel and concrete, which will form a part of the street railway tunnel under the Chicago River at La Salle Street, Chicago, is nearing completion, and it is expected that it will be sunk about December 1, 1910.

Refrigeration Congress for United States.

The next International Refrigeration Congress will be held in the United States. The time and place will be announced later.

W. C. L. Eglin.

The subject of this sketch, W. C. L. Eglin, has long been a prominent figure in the electrical industry. As a hard-working member of the American Institute of Electrical Engineers, the National Electric Light Association, and the Association of Edison Illuminating Companies, he has been a conspicuous example of the good that can be worked in the older organizations when young men of executive ability and with a passionate desire to do good service become interested in the administrative side of organization effort.

William Charles Lawson Eglin was born in Glasgow, Scotland, 1870. He received his training in the Andersonian University of that city, and in the West of Scotland Technological College; and assisted Rankin Kennedy in his early experimental work on alternating-current generators and transformers.

Coming to Philadelphia, he became connected with The Edison Electric Light Company of Philadelphia under Prof. William D. Marks, and had charge of the electrical construction in the first Edison plant in that city. Later, he was advanced to the position of engineer in charge of the electrical department, and continued in this position until the consolidation of the Edison Company with the Pennsylvania Heat, Light & Power Company, in 1896. Some time after this, he was appointed electrical engineer of The Philadelphia Electric Company, which controls all the lighting companies in Philadelphia and vicinity.

W. C. L. EGLIN,
Electrical Engineer of the Philadelphia Electric Company.

His work, after the consolidation of the various companies, required practically a rebuilding and rearranging of the entire system, in order that uniform service could be furnished throughout the city, several generating stations being enlarged and others remodeled as substations. A new generating station was also built at Twenty-eighth and Christian Streets, designed upon the unit basis, and is capable of being expanded to an ultimate capacity of 120,000 kilowatts. Its present capacity is 36,000 kilowatts. The number of substations built and equipped was thirteen.

The design of the substations—especially the alternating-current substations—was very carefully worked out by Mr. Eglin, the object being to make the alternating-current substations as flexible as possible, to meet the varying requirements of the districts to be served. As Philadelphia is the largest manufacturing city in the United States some of these districts were largely manufacturing; others, residence; and others, again, combined both manufacturing and residence districts. Throughout, Mr. Eglin's attention has been directed towards reducing to a minimum the work of the operator, whose principal function is the keeping of the plant and the apparatus clean. Some of the smaller substations have been designed to operate without the use of an attendant, there being merely an inspector who visits the plants ocasionally to see that everything is in proper working order, and to maintain cleanliness.

Mr. Eglin has taken a very active part in all the affairs of the company's progress, and has given particular attention to the various educational and beneficial organizations within the company, formed to enable its employees to improve their condition. There are, at present, three organizations within the company, viz., the Company Section of the National Electric Light Association, which includes the Meter Society as a branch; the Beneficial Association, and the Athletic Association.

Mr. Eglin represented the Franklin Institute and the Engineers' Club of Philadelphia at the Engineering Congress held in Paris, 1900; and was also a delegate to the International Electrical Congress held in St. Louis, 1904.

He has taken an active interest in the affairs of the American Institute of Electrical Engineers, having served as chairman of the local Section, and as a manager and one of the vice-presidents of the Institute.

He has also taken an active interest in the National Electric Light Association, having occupied the offices of secretary and treasurer, second vice-president, and president. During his term as president, the Association made great strides in activity; the membership more than doubled itself during that one year; and the balance in its treasury was materially increased. His work on the report of the Committee on Gas Engines attracted wide attention.

Mr. Eglin is also a member of the American Electrochemical Society; the Engineers' Club of New York; the Engineers' Club of Philadelphia; the Board of Managers, Franklin Institute of Pennsylvania; the Illuminating Engineering Society; the Bryn Mawr Polo, Racquet, Merion Cricket, Pen and Pencil, Philadelphia Country and Union League Clubs, of Philadelphia; and the Mohawk Club, of Schenectady, N. Y.

Electrical Protective League of Chicago.

The Electrical Protective League of Chicago (Ill.) was incorporated a short time ago with the object of protecting the electrical dealer against parties who have ordered and received goods with intent to defraud.

A number of times in the past electrical firms have been defrauded by persons who ordered goods by telephone and later sent a wagon to receive the purchase. The order and wagon were both purported to have come from a reliable dealer and the fraud was not discovered until the bill was sent to the firm which supposedly ordered the goods.

In the future all cases which are brought up will be prosecuted by a lawyer who has been retained by the League, and the expenses of such prosecution will be borne by it instead of by the firm which has been defrauded.

The officers of the League are: President, Louis A. Schwab, Monarch Electric and Wire Company; treasurer, N. G. Harvey, Illinois Electric Company; directors, Mr. Schwab, Mr. Harvey and F. M. Pierce, of the Manhattan Electrical Supply Company; F. Overbagh, of Overbagh & Ayres Manufacturing Company, and James Wolff, of the New York Insulated Wire Company. The office of the League will be at 411 South Clinton Street.

Traction Situation in Toledo.

Following the expiration of the franchises of several of the most important lines operating in Toledo, O., Mayor Whitlock notified the Toledo Railways & Light Company that it was trespassing on the city streets.

The mayor explained that while the franchises had expired the necessity for public transportation continues, and as the public right is paramount to all other rights, the administration is disposed to suffer the continuance of street car operations temporarily, pending some tentative arrangement for the use of the streets until the solution of the whole problem.

Experts of the city are now figuring upon a possible rental value of the expired franchises for a period, and it is possible that a rental basis will be arrived at which will prove satisfactory until such time as the matter can be finally settled. In the meantime the notice served by the mayor is intended to prevent any waiver of the city's rights in case of possible future litigation.

The situation is a perplexing one and although negotiations have been under way for many months with a view to renewing franchises, very little headway has been made, and the problem is apparently little nearer a solution than it was last spring. The barrier seems to be almost an impassable one and no one can even predict the conclusion. The present city administration was elected to office on a platform which declared in positive terms for three-cent car fares. The street car company claims that such a franchise is an impossibility under existing conditions, the cost of operation precluding the idea.

Shortly after negotiations were opened the City insisted upon the settlement of all old indebtedness owing to the City, consisting of many thousands of dollars of unpaid paving assessments. The matter was satisfactorily adjusted and negotiations proceeded. Next came a proposition that the street car company throw open its books and records to the inspection of experts acting for the City, that a correct valuation of street car assets might be reached, but with the understanding that the report of the investigators should be in no sense binding upon the City. The firm of Nau, Tanner & Rusk spent weeks in investigation, and submitted a voluminous report of the physical property of the Company. The matter was apparently dropped at this point and the franchises have now expired with no solution. H.

McKinley Bridge Dedicated.

The McKinley bridge of the Illinois Traction System, extending across the Mississippi River at St. Louis, was dedicated on November 10 in the presence of about 3,000 invited guests. The bridge is named after Congressman W. B. McKinley, president of the Illinois Traction System, and is the first bridge to be built across the Mississippi by an electric railroad company exclusively for its own use. Formal dedication was made by Governor Hadley of Missouri and Governor Deneen of Illinois, the structure being blessed by Archbishop J. J. Blennon of St. Louis. The ceremonies were followed by a banquet and a display of fireworks. S.

Philadelphia Section Programme.

The next regular meeting of the Philadelphia Electric Company Section of the National Electric Light Association will be held on Monday evening, November 21. The papers of the evening will be "The Increasing Prominence of Illuminating Engineering as Recognized by Technical Societies and Universities," by G. Bertram Regar, and "The Possibilities of Electricity," by James H. Dentry.

Electrometer for Length Measurements.

At the meeting of the Paris Academy of Sciences on October 24, Jean Villey showed how an electrometer could be used for the exact measurement of very small displacements. A condenser is formed of two parallel plates and charged, and small displacements of one plate change the potential and consequently the reading of the electrometer which is connected to the condenser. With circular plates of 13 centimeters diameter and 0.158 millimeters apart charged to 176 volts, and an electrometer indicating 150 centimeters per volt on a scale distant 350 centimeters, a motion of 0.001 millimeter of one plate produces a deflection of over 150 centimeters or a magnification of over 1,500,000. The sensibility, therefore, exceeds that of interference methods.

Nobel Prizes for Physics and Chemistry Awarded.

The Nobel prizes for physics and chemistry have been awarded, Prof. Van der Waals, of the Amsterdam University, receiving the former, and Prof. Otto Wallach, of the University of Goettingen, being awarded the prize for chemistry.

Electric Crane Installation at Zanzibar.

Consul A. W. Weddell, of Zanzibar, advises that the customs department of the Zanzibar government is preparing to install two five-ton electric cranes for handling freight from lighters, displacing two small steam cranes now in use; all cargo at this East African port is handled by lighters.

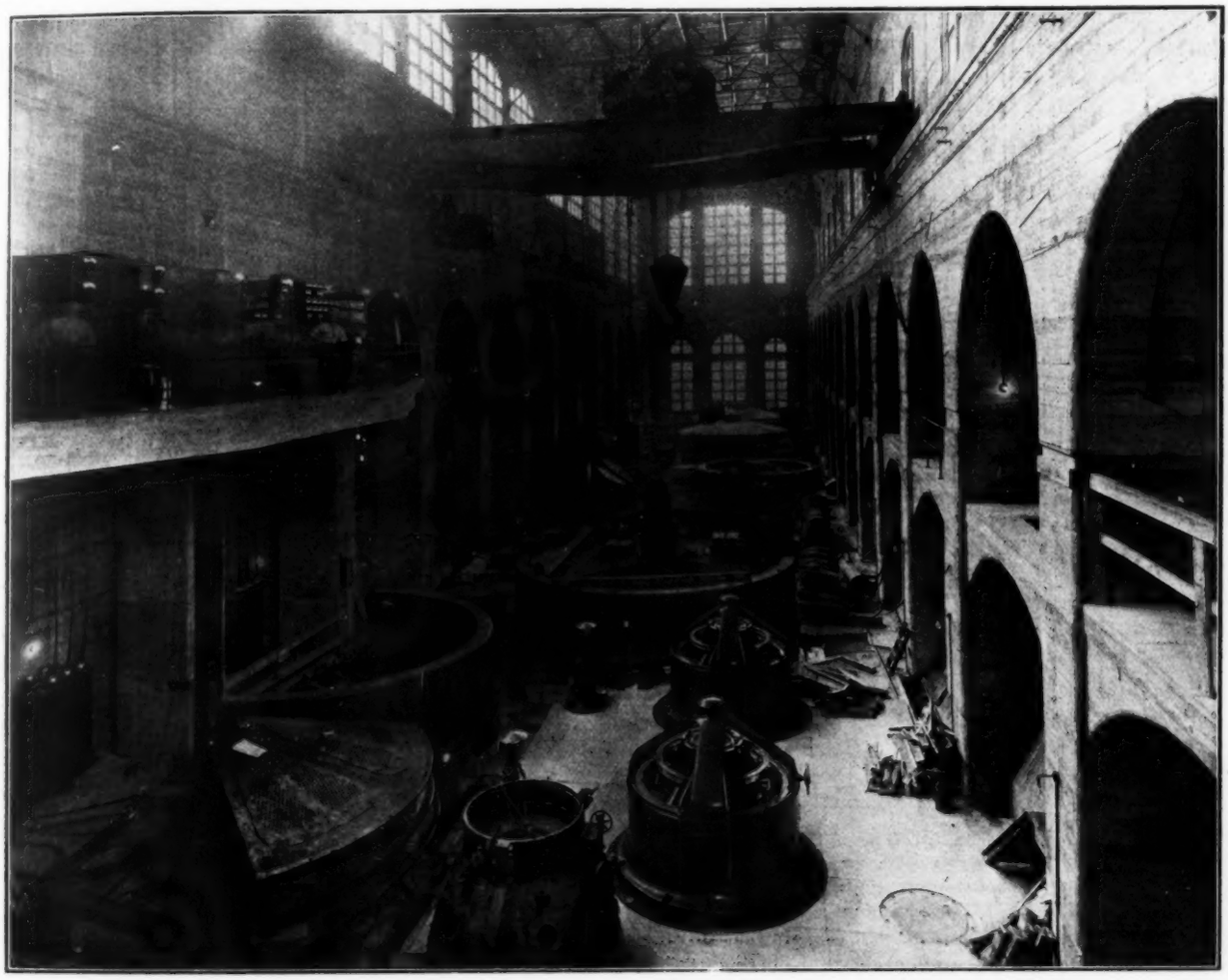
Wireless Station for Argentina.

The Argentine Government has appropriated $8,500 United States currency for a wireless-telegraphy station in Mendoza, which will be in direct communication with Valparaiso, Chile.

The McCall Ferry Hydroelectric Project.

Description of the New 135,000-Horsepower Plant of the Pennsylvania Water & Power Company.

Next to the St. Lawrence River, the Susquehanna River is the largest stream flowing into the North Atlantic Ocean. The river finds its source in New York and northern Pennsylvania, and the total area drained is about 27,000 square miles. Over this tremendous area the annual precipitation is approximately forty-two inches. Located on this river, about ten miles northwest of the boundary line of Maryland and twenty miles from the tidewater of Chesapeake Bay, at a point known as McCall Ferry, is the new 135,000-horsepower hydroelectric plant of the Pennsylvania Water & Power Company.



GENERAL VIEW OF GENERATOR ROOM AT PENNSYLVANIA WATER & POWER COMPANY'S PLANT.

Although work on the plant was started in 1905 and progressed rapidly, operations ceased in 1907, owing to business depression, and it was not until August of 1909 that work was resumed. Since that time it has progressed rapidly and on October 14, 1910, the first two 7,500-kilowatt generators were placed in operation. Preliminary description of the project appeared in the ELECTRICAL REVIEW for June 1, 1907, and the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN for February 27, 1909.

The location of the plant of the Pennsylvania Water & Power Company is highly advantageous from the standpoint of an available market. Philadelphia, Baltimore, Wilmington, Harrisburg, York, Lancaster, and many other cities and towns noted for their manufacturing industries are within a radius of seventy-five miles. At the present time, however, the only transmission line of the Company extends to Baltimore, a distance of forty miles.

For construction purposes the site of the plant is highly favorable on account of the steep banks on each side of the river, a large island in midstream, and a narrow gorge between the eastern bank and a chain of islands which forms a natural tailrace. A fall in the river, due to a series of rapids above this point, makes available for hydraulic purposes a total head of about sixty-three feet.

The Susquehanna River is subject to extremely high fluctuations, the maximum flood discharge being approximately 225 times the maximum stream flow. It was owing to this condition that the dam has been built as a spill-

way section for its entire length of 2,350 feet, and with this length the maximum flood is estimated to cause a head of seventeen and one-half feet on the crest. In the construction of the dam and plant extreme precaution was taken to guard against ice.

THE DAM.

The dam, 2,500 feet in length, is said to be the second longest dam in the world. Its crest is about forty-five feet above the normal low-water level, its maximum height above the foundations is sixty feet, and the width at the base is sixty-five feet. The dam is of concrete construction, about 174,000 cubic yards being used.

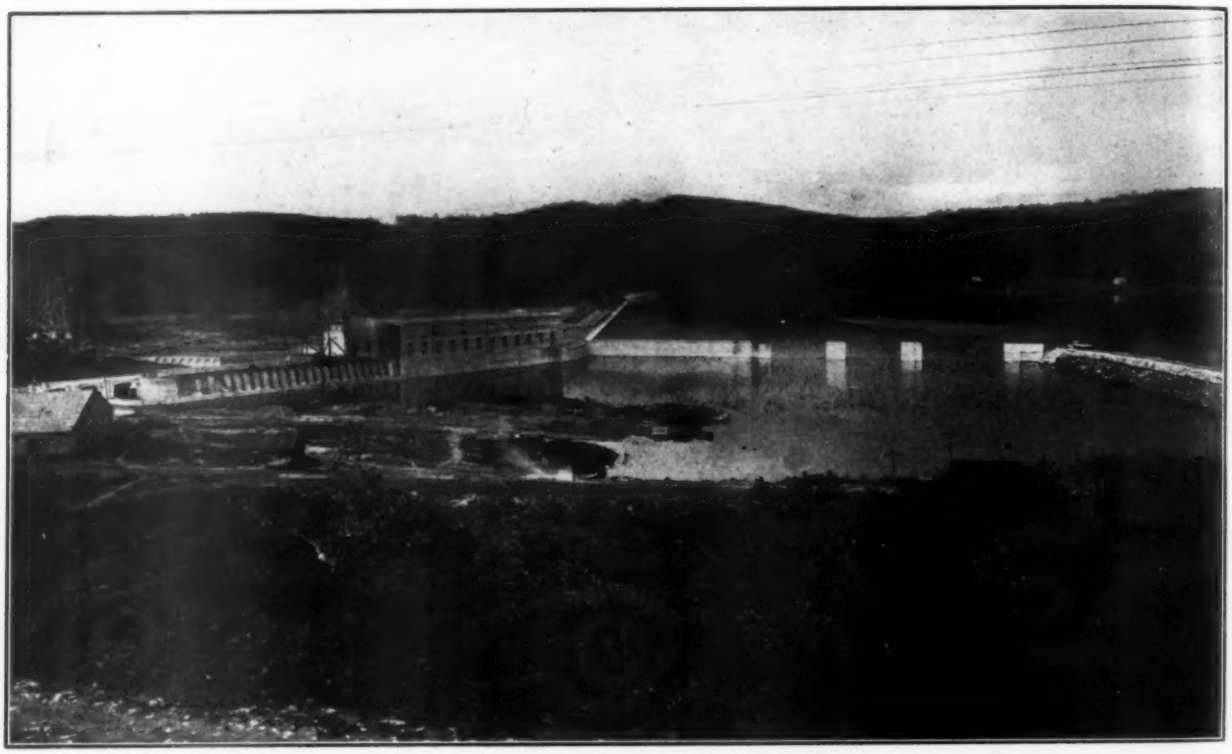
piers. Between the power house and the shore is an ice spillway, forty feet wide, which is used to clear the forebay of ice. The crest of this spillway is at the same elevation as the crest of the main spillway.

The tailrace is a natural channel which extends about 2,000 feet below the dam. Beyond this point it was necessary to excavate a channel through solid rock. A number of small dams are located, parallel to the river flow, between the small islands down stream from the dam. These are for the purpose of deflecting the tailrace from the main channel. A deflection dam is also constructed immediately

POWER HOUSE.

The power house is approximately parallel to the flow of the river and is located at an angle of about thirty degrees from the dam. It is of concrete construction, with a steel superstructure. The penstocks, wheel chambers and draft tubes are also of concrete construction. The length of the plant is 500 feet and its width is fifty feet.

The ultimate capacity of the plant will be 135,000 horsepower. The generating equipment will comprise ten main units, three of 7,500-kilowatts and the remaining at 10,000-kilowatts capacity. For the present, however, the construction will be completed for



GENERAL VIEW OF THE McCALL FERRY HYDROELECTRIC PROJECT, McCALL FERRY, PA.

An idea of the general arrangement of the dam and buildings may be gained from the accompanying view. The forebay is divided from the river by a rock embankment extending out 300 feet from the shore. An ice protection system consisting of submerged arches and floating booms extends from the junction of the power house and dam to a short distance from the embankment mentioned above. The crowns of the submerged arches are about two feet below the low-water level. The space between these arches and the rock embankment is closed by floating booms guided by concrete below the power plant and extends 576 feet to Piney Island.

The gate house adjoins the power house and is divided from the forebay by a line of submerged arches. The trash screens are immediately back of these arches and are supported on concrete piers. The piers are six feet apart and the entrances are sixteen feet high. There are four of these entrances to each of the main turbine penstocks and they empty into a huge tube thirty feet wide. The head-gates are of steel construction, and for the present are operated by a fifteen-ton crane which spans the gatehouse.

six main units and two exciters. When additional capacity is required the power plant will be extended and additional units added. This will be a comparatively easy task, as the foundations, etc., are completed for the full installation of 135,000 horsepower, the only work required being the completion of the superstructure.

The water wheels are of the vertical-shaft type, each capable of developing 13,500 horsepower when operated at a fifty-three-foot head with eighty per cent gate opening. They operate at a speed of ninety-four revolutions per minute. The design of the

turbines is such that with the available head reduced to the minimum during extreme floods they will be capable of giving the full output with 100 per cent gate opening. At times of ordinary flood the minimum head available will be fifty feet, and at times of low water the available head will be sixty or sixty-five feet.

Two turbines are mounted on a single shaft of forged steel, which is in one piece from the bottom to where it is coupled to the generator shaft. The entire weight is carried on a roller-bearing, which is supported on a casting set into the masonry. The upper turbine discharges through a steel casing bolted to a thimble embedded in the end of the up-stream draft tube. The lower turbine discharges directly downward into the lower draft tube. Both are supplied with water through twenty distributing vanes, each 3 feet 4 inches in height. The draft tubes come out together below the level of the standing tail-water. It is thus possible to get at the upper turbine by closing the head-gates. When the lower turbine requires attention stop logs may be dropped in, which will cut off the tail-race so that the draft tube can be drained by electric pumps.

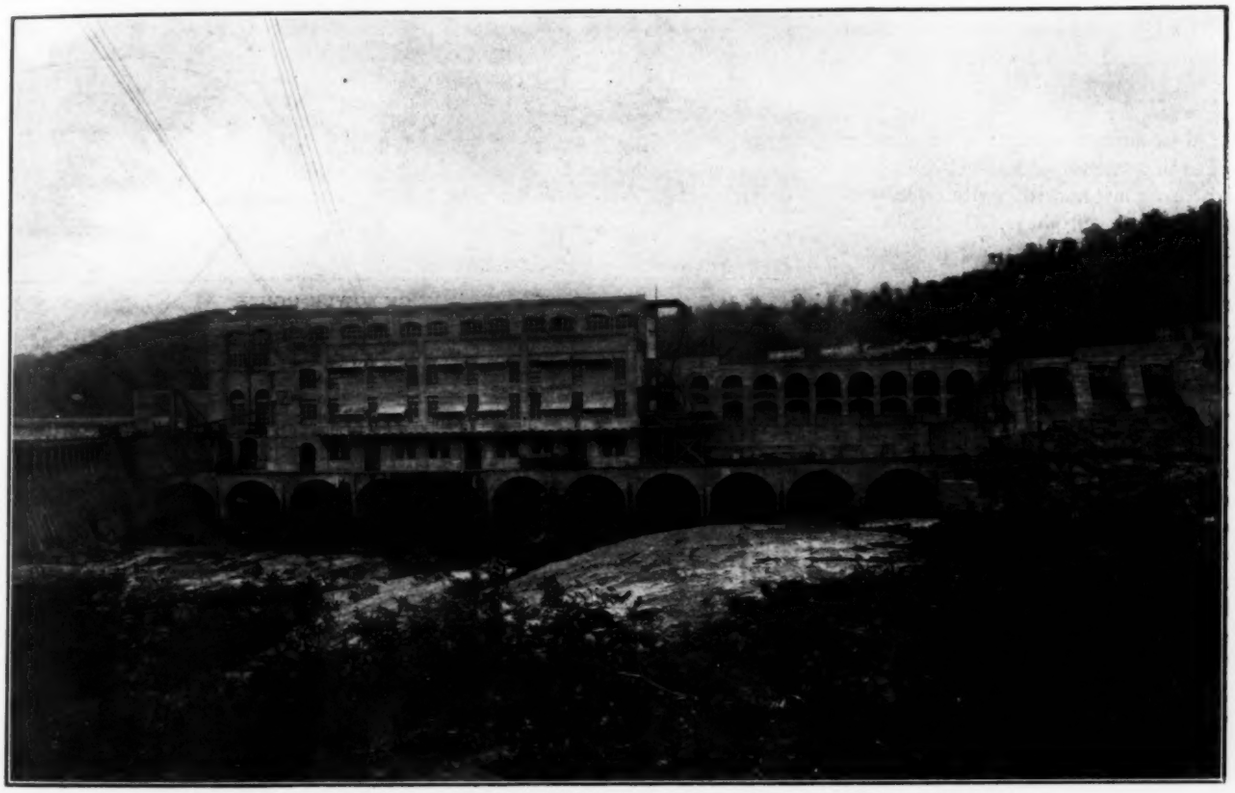
The arrangement for operating the gates consists of a vertical shaft made of pipe carried on a step and held at the top by a bearing attached to the wall. The accompanying cross-section of the power house shows the large water ways from the forebay to the ends of the draft tubes. The maximum velocity of flow in the concrete openings is only six feet per second, and all changes of direction of flow have been made as gradual as possible to avoid loss of head.

The exciter turbines are of the same type as the generator turbines and all were supplied by the I. P. Morris Company, Philadelphia, Pa. The turbines are controlled by governors of the double floating-lever type.

The generators are placed in single row along the center of the generator room. The accompanying view of the interior of the room gives a general idea of the arrangement. Starting at the west wall, each of the first three generators has a capacity of 7,500 kilowatts and the remaining generators a capacity, each, of 10,000 kilowatts. They generate three-phase, twenty-five-cycle current at 11,000 volts, operating at ninety-four revolutions per minute. The field current is supplied by two 1,000-horsepower water-driven exciter sets located in a line with and east of the first five units. The exciter sets operate at 240 revolutions per minute, generating 250-volt current. A view of these exciters is shown in one of the accompanying illustrations.

The connections from the generators and exciters to the respective busbars are made through single-conductors, each run in separate ducts laid in troughs along the power-plant floor and through iron conduit to the switchboard floor level.

The main switchboard consists of twenty panels and is located on a protruding gallery overlooking the main generating room, at the west end of the plant. Its equipment is very complete and provides indicating and recording instruments for each of the generator circuits, as well as a comprehensive outfit of regulating and switching devices. All switching operations on the 11,000-volt and high-tension circuits are remote-controlled, solenoid-operated, oil switches being used. The entire equipment of oil switches is located in the transformer house on the same level as the switchboard gallery. A view of this equip-



VIEW OF POWER HOUSE SHOWING TAILRACE, McCALL FERRY HYDROELECTRIC PLANT.

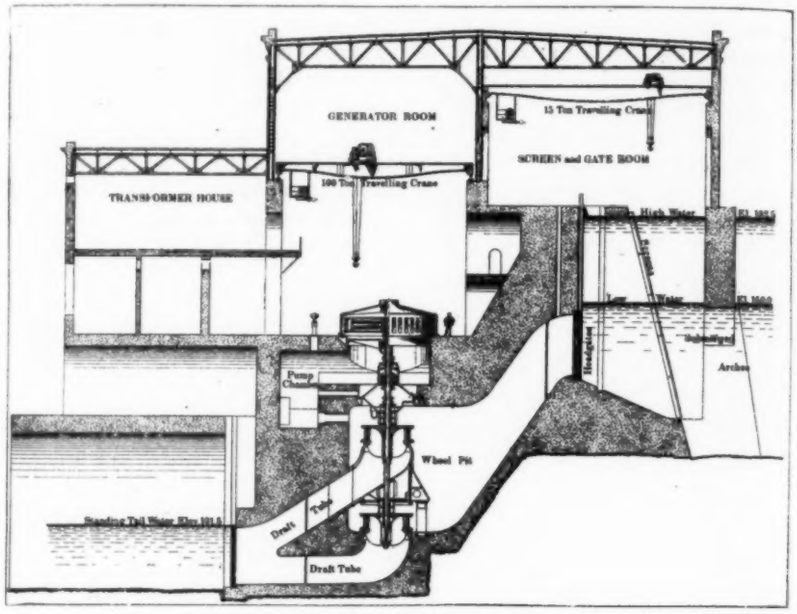
ment is shown in one of the accompanying illustrations.

At the left hand, when standing in front of the main board, are two exciter panels, each being equipped with a voltmeter, ammeter and circuit-breaker of suitable range. Two sets of exciter busses are provided, to either of which each exciter may be connected, thus enabling them to be operated either independently or in parallel. Next in order are the panels for the joint or independent control of the exciters in connection with a voltage regulator.

Adjoining these panels are the main generator panels, which are each provided with a field ammeter and field switches connected to either exciter buss. Each panel is also provided with an indicating wattmeter, an integrating watt-hour meter, a voltmeter for connecting across each machine phase and an ammeter with switch for connecting into each phase. On the bench board are the plug controls for the oil switches connecting the generators to either of the 11,000-volt busses. Each of these controls is provided with a red and green pilot lamp. For each generator there is also located on the bench board a plug control for the motor controlling the turbine that can change the speed of the unit. In adjusting the speed during synchronizing this plug when pulled forward starts the motor one way, and when pushed back starts it the other way. Plug controls for the oil switches connecting the transformers with the 70,000-volt buses are also provided.

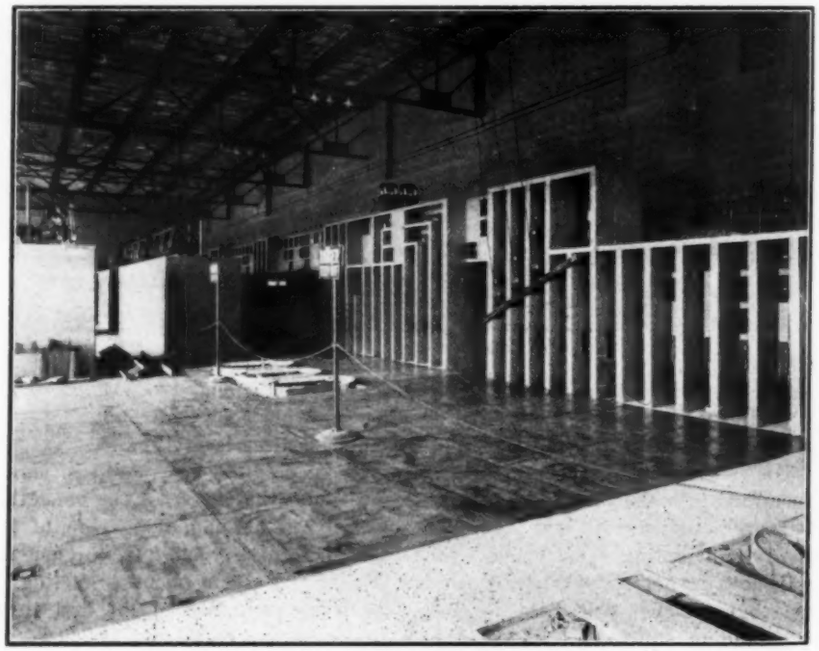
The station switchboard forms a part of the main board and controls the circuits for lighting and motor service throughout the plant. These circuits are intended to be run normally from the station step-down transformer, which reduces the current to 250 volts. However, provision is made for connecting the lighting and station motor circuits to the exciter sets. For further precaution against accidents a storage battery of suitable capacity to carry the lighting and a portion of the station-power load is being installed. The lighting of the plant and adjacent buildings is accomplished entirely by tungsten-filament lamps of high candlepower.

Among the motors controlled from this board are two vertical-type fifty-horsepower drainage motors, motors for operating the two electric cranes, eight-horsepower motors for operating oil-circulating pumps for cooling transformers and two eight-horsepower motors for operating the lubricating oil pumps.



CROSS SECTION OF POWER HOUSE.

The 11,000-volt busses and all of the oil switches are located on the second floor of the transformer house, which is on a level with the switchboard gallery. A view of this floor is shown herewith. The 11,000-volt busses are sectionalized, so that at one side are the transformer and generator switches and at the other the switches for the station circuits. The busses can be tied together through any generator or other oil switches connected with them. In the control equipment for the oil switches provision is made so that no machine or transformer can be put on the bus except through the six-panel plug on the benchboard.

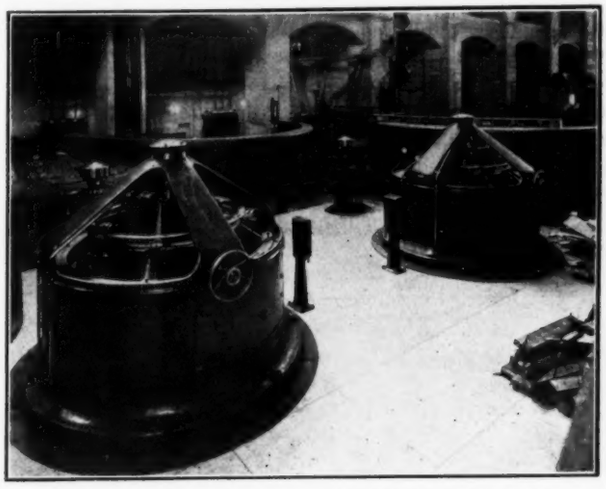


HIGH-TENSION BUSBARS AND OIL SWITCHES.

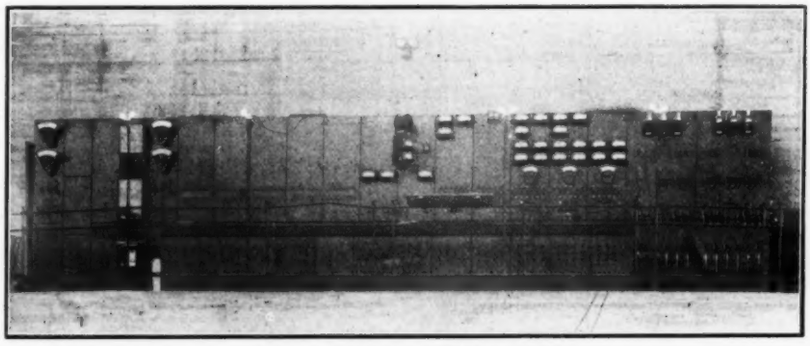
The step-up transformers for the

high-tension lines are located in separate bays on the first floor of the transformer house and directly south of the line of generators. The first three transformers, starting from the west wall, are 7,500-kilowatt, oil-cooled, and the remaining are 10,000-kilowatt transformers. Each of the high-tension leads, leaving the transformer, after passing through a disconnecting switch, divides into two branches, one running to the outgoing line and the other through a disconnecting switch to a tie oil switch. The other branch of the line passes through a disconnecting switch, a similar line oil switch and through the series relays and choke coils to the high-tension windows and out to the tower line.

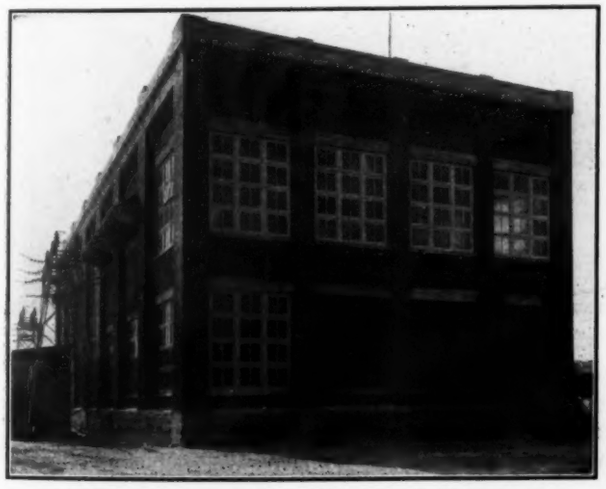
TWO OF THE 7,500-KILOWATT GENERATORS.



VIEW OF THE TWO 1,000-HORSEPOWER EXCITERS.



VIEW OF MAIN SWITCHBOARD.



BALTIMORE SUBSTATION SHOWING INCOMING LINES.

INTERIOR OF SUBSTATION AT BALTIMORE.

Connections are made from this window to lightning arresters, a tap line running through horn gaps that are mounted on a gallery outside of the building, over the tailrace. The ground side of the horn gaps is connected through wall insulators to a set of aluminum-cell lightning arresters, mounted near the south wall inside of the main building.

The barriers for the high-tension busses in the transformer house are built entirely of concrete. The compartments are located on both sides of a twelve-inch division wall about 110 feet long. The shelves and barriers of the high-tension structure are all four inches thick.

TRANSMISSION LINES.

At the present time the Pennsylvania Water & Power Company is

operating only one line—to Baltimore, a distance of forty miles—although next spring work will be started on similar lines to other neighboring towns. The line to Baltimore, known as transmission line No. 1, comprises two 70,000-volt circuits, each of three aluminum cables. About 500 steel towers are used, ranging in height from forty to sixty feet. The average distance between towers is 423 feet, but this is lessened at railroad crossings and other points, such as curves, crossings, etc.

The Company owns a private right-of-way, 100 feet wide, extending from the plant to the city of Baltimore, and a private telephone line is installed the entire length of the transmission system.

An idea of the construction of the towers may be gained from the accompanying illustration. The entire tower is built of galvanized steel and is of the four-post pattern. For carrying the line wires, which are suspended from triple-unit suspension-type insulators, three brackets are provided on each side of the tower. A feature of the transmission system is the span across the river at the power house. At this point the lines cross the Susquehanna by a span over 2,000 feet long on specially constructed towers 120 feet high.

The contract of the Pennsylvania Water and Power Company with the Consolidated Gas, Electric Light & Power Company, of Baltimore, calls for the delivery of 25,000 horsepower the first year, and this amount will be increased yearly during the life of the contract.

SUBSTATION.

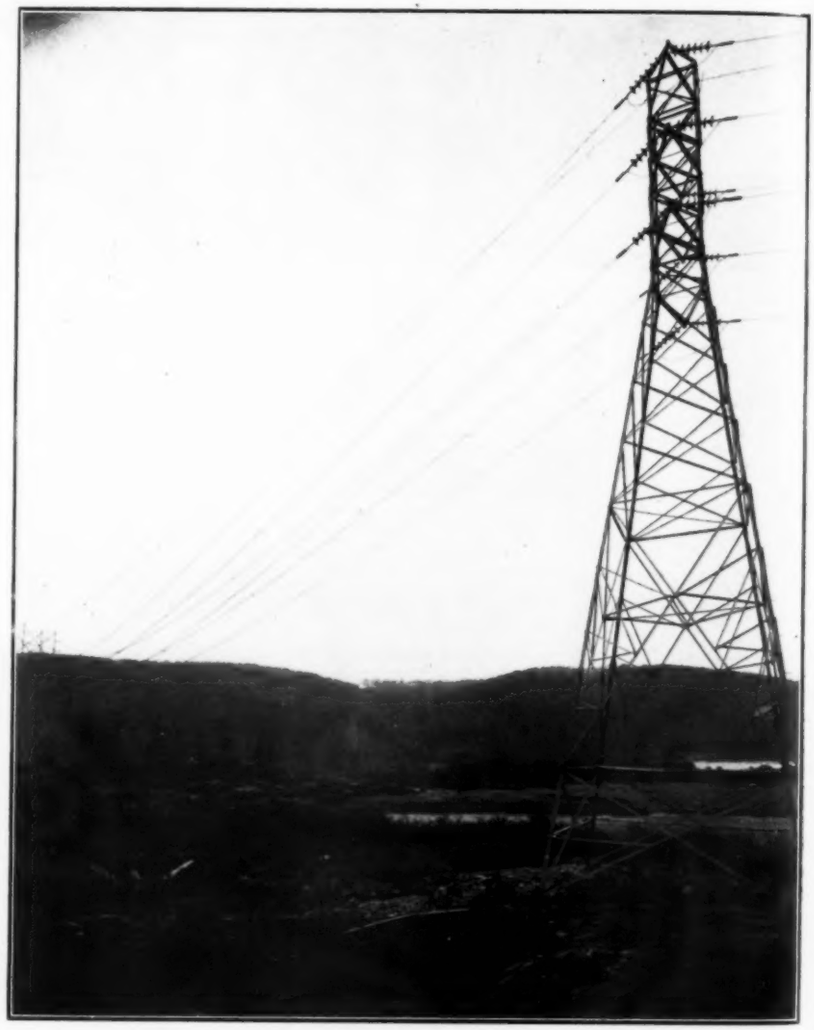
For receiving this power and transforming it for use in Baltimore a large reinforced concrete and brick substation has been built on the outskirts of the city at a point known as Orangeville. This station, which is 75 feet by 175 feet in size, has been equipped with all of the necessary apparatus for receiving, transforming and distributing to purchasers about twice the amount of current at present called for, and further provision has been made for any increases that may be required.

There are four transformers at present installed, each having a capacity of 10,000 kilowatts. Each of the transformers rests upon a heavy base mounted on wheels and is so arranged that it may be moved into range of the sixty-ton electric traveling crane spanning the station, and may thus be easily moved for making repairs.

Power is received at the substation at 70,000 volts, and is stepped down to 13,500 volts. The outgoing current leaves the station in cables placed in underground conduit.

In the accompanying illustrations of the substation, the exterior view shows the incoming lines on the transmission towers. In the interior view are shown the motor-operated oil switches encased in separate reinforced concrete compartments for handling the incoming current at 70,000 volts and the outgoing current at 13,500 volts. The transformer installation in the substation was furnished by the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. All other electrical equipment in the substation and plant was furnished by the General Electric Company, Schenectady, N. Y.

The officers of the Pennsylvania Water and Power Company are: J. E. Aldred, president; Charles E. F. Clark, treasurer; and Sherman L. Lewis, secretary. The entire construction of the project is in charge of J. A. Walls, chief engineer for the Company. The estimated cost of the project is over $10,000,000.



STEEL-TOWER LINE SHOWING SPAN OVER RIVER.

McAdoo Extension Opened.

The McAdoo extension of the Hudson Tubes in New York were opened on November 10, completing for the present the work of the McAdoo System.

Exports of copper for the week ending November 10, were 4,670 tons; since the first of the month, 7,944 tons; and last year the figure was 8,084 tons.

RECENT HYDROELECTRIC DEVELOPMENTS IN THE WEST.

ADDRESS BEFORE THE CHICAGO ELECTRIC CLUB.

The meeting of the Chicago Electric Club on Wednesday, November 9, was a most successful one from every point of view. The attendance was large and the speaker of the day, James Lyman, district engineer, General Electric Company, Chicago, delivered a very interesting address on "Recent Hydroelectric Developments in the West."

Mr. Lyman said in part:

The vast resources of our country especially that west of the Mississippi River, were first opened by the railroads.

The rapid growth and prosperity of certain localities on the Pacific Coast date with the coming of hydroelectric power. With it came extensive electric railroads, electric lighting and electric drive and in certain other inland sections, hydroelectric power makes possible the irrigation of immense tracts of arid land, transforming them into the most fertile and productive on the continent.

High up in the Sierra Mountains at Herhoult, Cal., iron is now being smelted in an electric furnace at a cost of less than it can be otherwise obtained and of a quality which compares with the finest Swedish iron. The rapid advances in electrochemistry find continually new applications for electric power and in those sections of the West where fuel is expensive hydroelectric power opens new sources of wealth.

Public attention is today directed to the conservation of our national resources, and well it may be, for our great timber forests are being cut and damaged by fire at a rate far in excess of their growth; our coal is being consumed at a dangerously increasing rate and nature's store of nitrates and other fertilizers are being exported, leaving much of our extensive farm land to lose its virgin fertility.

The first step in conservation of our national resources should be the efficient development of our great water powers. Unlike our forests and our coal and other minerals, our water powers are perennial.

With the proper protection of our forests we can count on the continual power of our rivers, and this in a large measure without destroying their scenic beauty. The development of their power wherever practicable, not only stimulates business and enriches the community served, but it saves the fuel which otherwise would be consumed in supplying in a more meager and expensive way the power actually used.

Thus far practically all the water power developed in this country has been by private enterprise and capital. Some of the larger and more recent plants which I have just visited and will briefly refer to involved great engineering difficulties, interesting features of design and operation and were built at a cost of millions of dollars. Such developments can only be carried out by large financial interests and in most cases the return on the capital invested is hardly more than enough to justify the expense and the risks involved. Each instance, however, is or promises to be a distinct stimulation to business in the locality it serves.

The laws governing the rights for hydroelectric development are inadequate and indefinite. The subject should command the careful and immediate attention of Congress and such new laws made as will safeguard private capital so invested.

There may be reason in the contention that the water-power rights of our country should not be forever granted to private corporations, but the private corporation which is willing to promote them becomes a public benefactor, like the inventor who introduces some great economy, and like the inventor, in my opinion, the corporation should for a limited time, say forty or fifty years, reap all the profits of the development and later such adjustments in power rates or such division of profits with the government should be made as will surely safeguard the large capital investments by the corporation. Only by so safeguarding can private capital be induced to develop our water powers.

And now for a brief sketch of several interesting developments. *First*—The Central Colorado Power Company, with its two power houses; one at Boulder, thirty miles north of Denver, and the other at Shoshone, in the wild canyon of the Grand River, high in the Rocky Mountains, fifteen hours' ride by train from Denver, but only 150 miles by air line. The 100,000-volt transmission is carried over the Leadville Divide, 10,000 feet elevation and across the roughest country—the most difficult piece of transmission work ever undertaken.

The placing of the steel towers and stretching of the heavy cables in spans, some of more than 2,000 feet, was a hard task, but so well done that little trouble has been experienced in the year's service. The Shoshone power development consists of a masonry dam and a tunnel seventeen feet wide by twelve feet deep, 2.5 miles long, cut through solid granite rock close to the face of the canyon, down stream 170 feet above the power house tail race. Here two 5,000-kilowatt horizontal water turbine units are installed. A further development a little further down the stream will increase the power to 15,000 kilowatts and a second a few miles above will provide another 10,000 kilowatts. Double this power can be developed, or 50,000 kilowatts, seven or eight months of the year and probably w[illegible] distant date.

The Boulder power development is equally interesting. A little stream of but ninety feet per second minimum flow is piped down an almost precipitous mountain side, 1,800 feet vertical height to two 5,000-kilowatt impulse wheels, and passes out into the atmosphere as white foam and a rainbow, while the electric power joins that from Shoshone at Denver terminal station over the 100,000-volt transmission line. At present the Denver Gas & Electric Company is the largest customer.

Passing on to the Coast, the high fuel cost has made California the pioneer in hydroelectric developments. Water powers of every size and description aggregating more than a half-million horsepower are in service. It is estimated that there is a total of 9,000,000 horsepower in California available for development, although most of it only at a high cost per kilowatt delivered at the nearest market. Only five and one-half per cent of the available power is, therefore, now developed. Three groups of these water powers are of special interest, as they demonstrate the feasibility of successfully and efficiently supplying current for all kinds of work over hundreds of square miles of territory, the power being furnished from any number of water wheel and steam turbine-driven units located at widely different points.

As a rule the water powers feeding over long high-tension transmission lines are operated under nearly constant load, thereby obtaining the maximum efficiency of the water wheels and transmission, while the turbine stations generally located nearer the center of distribution system take the load fluctuations and control the frequency.

The voltage of the distribution system is controlled by Tirrill regulators connected to the excitation circuits of synchronous motor-generator sets or rotary condensers. The first of these groups is the Pacific Gas & Electric Company of San Francisco. This company has developed the largest distribution system in the world. With more than 1,000 miles of three-phase 60,000-volt transmission lines, it supplies nearly 100,000 kilowatts for power and lighting to 153 cities and towns over an area approximately 200 miles north and south and 100 miles east and west, to one-half the population of California. Power is supplied from eleven water-power houses and three steam-power houses, some of them more than 300 miles apart. All are controlled by a single power dispatcher, who has become so expert that trouble occurring at any point can generally be located and the section cut out in three or four minutes, usually without cutting off any of the power houses or disturbing the voltage regulation of the system for more than a few minutes.

The largest power supply for this company is from the Feather River power house of the Great Western Power Company, located 154 miles northeast of Oakland, and this is remarkable in having the largest and most efficient water turbines, water wheel-driven generators and step-up transformers ever built. Each is normally rated 10,000 kilowatts and capable of twenty-five to fifty per cent overload.

Further, the water head, 430 feet, is the highest under which turbine wheels have ever run. The full load efficiency of the wheels is eighty-nine per cent; the full load efficiency of the generators is ninety-seven and one-tenth per cent; the full load efficiency of the transformer is ninety-nine per cent, giving a total efficiency from water to 104,000 volts of eighty-five and four-tenths per cent. With a transmission line loss of thirteen per cent and step-down transformer efficiency ninety-nine per cent the total delivered efficiency from water to the 60,000-volt distribution system 154 miles from power house is 73.5 per cent. The Great Western Power Company's present development consists of four of these 10,000-kilowatt units. The Company owns rights available for development further up the river for approximately 200,000 kilowatts.

The second of these groups is the Stanislaus Power Development, 130 miles due east of San Francisco, operating over 104,000 volts double transmission line, supplies the United Railways Company of San Francisco with a large part of its power in parallel with steam turbine units.

It is one of the most expensive and difficult water developments in the West costing with the transmission and terminal station more than $12,000,000. The power house is situated in the middle of a great bend in the deep canyon of the Stanislaus River, a sheer 1,500 feet below the canyon's rocky rim where the sun only shines a few minutes of each day. The water is brought fifteen miles along the edge of the canyon in a large wooden flume to a point above the power house and into steel pipes to four 7,500-kilowatt impulse water wheels operating under a 1,500-foot head.

The third group supplies power to Los Angeles. The Kern River Development, consisting of four 5,000-kilowatt waterwheel units supplying power over an eighty-mile line to Los Angeles at 80,000 volts, runs in multiple with a half dozen smaller water powers and a steam-turbine power house. The power is controlled and regulated substantially as described above with most satisfactory results. A large part of the power is supplied to the Pacific Electric Railway Company, one of the largest and best managed interurban systems in the country. Several miles of road connect all the little towns and seashore resorts out of Los Angeles. It has also contributed

much to the phenomenal growth of this beautiful "Playground of America."

And here I should mention the Owens River Aqueduct, now being built by the City of Los Angeles at a cost of $23,000,000. It is 240 miles long, with a capacity to deliver 260,000,000 gallons daily, or 400 sectional feet. Construction work began three years ago and will be completed in a little more than two years. It starts at the base of a group of twenty-four snow-capped mountains in the Sierra Range, each more than 13,000 feet high; Mt. Whitney, 14,500 feet in the center. Thirty-five small streams flow together, making the Owens River and this whole river of pure, sparkling mountain water is brought through concrete ditches and tunnels in the mountains through a closed concrete aqueduct 125 miles across the Alkali Desert. One hundred and twenty thousand horsepower is available from the water of the aqueduct. 80,000 horsepower from three falls located respectively 45, 36 and 20 miles from Los Angeles. After passing the last falls the water enters two large reservoirs 1,000 feet above the city of Los Angeles. From these reservoirs it will be conducted to the city and surrounding country for water supply and irrigation.

At Spokane, the Washington Water Power Company is just completing one of the best hydroelectric developments I have seen at Little Falls, thirty-five miles northwest of the city. Four 5,000-kilowatt horizontal generator units, each driven by a pair of turbine wheels under a sixty-seven foot head, good for a total continuous load of 25,000 kilowatts. The power is sent to Spokane over two single steel-tower lines at 60,000 volts and runs in parallel with several other water powers and steam turbine units.

This company has 450 miles of 60,000-volt lines supplying power, not only for all purposes in Spokane, but to the Coeur d'Alene Mines, 100 miles east of Spokane. New developments under consideration will soon bring the total capacity to 100,000 kilowatts.

The Great Falls Power Company has just completed a hydroelectric development at Rainbow Falls of 21,000 kilowatts in six 3,500-kilowatt horizontal generator units running under a head of 107 feet. Two independent transmission lines on steel towers carries the power at 100,000 volts the 150 miles to Butte. A proposed development at Great Falls, six miles below Rainbow Falls, will provide 65,000 kilowatts additional power and a second smaller development between the two will bring the total to 100,000 kilowatts.

It is proposed to do away with the large steam plants at the thirteen Butte Copper Mines and operate the hoists by compressed air, furnished by electrically-driven air compressors. These plants now use 25,000 horsepower in steam hoists.

SUMMARY.

Great advances have recently been made in the building of masonry dams, aqueducts, flumes, etc.; the design, size and construction of water wheels, both of the reaction and impulse types; the development of high-tension electrical apparatus, including transformers, line insulators, steel towers, etc.; in control and protective devices; and in the systematic operation of large interconnected power lines.

At least five heavy power transmissions are successfully and economically delivering current from 50 to 150 miles at from 100,000 to 110,000 volts.

All apparatus used is standardized. The aluminum-cell electrolytic arrester has largely disposed of disturbances from lightning and surges. The line charging currents in combination with synchronous motor-generator sets or rotary condensers regulate for constant delivered voltage.

Today power is being handled at 100,000 volts over 150 mile lines as satisfactorily and as efficiently as ten years ago; when it was handled at 50,000 volts over half of this distance. Above 110,000 volts air begins to lose its perfect insulation qualities and a slight leakage or discharge from the conductor takes place, known as the "Corona" effect. We cannot say how much higher than 110,000 volts can be efficiently used.

Transformers, oil switches and line insulators can all be built for much higher voltages; the insulation of the air alone, therefore, limits the line potential.

With the successful development of large motors for driving rolling mills and the fly wheel type of hoists for deep mine work, electric power can be successfully substituted for every possible application of power today, therefore, wherever water power is available it is possible to use it as a substitute for steam, and in localities where fuel is expensive, available water power should be developed and companies organized for its development should receive the co-operation and support of the public.

The discussion was opened by D. W. Roper, assistant chief operating engineer, Commonwealth Edison Company, who briefly referred to a trip he recently made in the territory referred to by the speaker. He called attention to a few minor hydroelectric developments in California which were not visited by Mr. Lyman.

A. A. Gray called attention to civic questions which hydroelectric developments will eventually place before the public for settlement.

Brief remarks were also made by Messrs. Sager, Wheeler and Bennett.

Address at Manchester Meeting.

J. S. Peck, the new chairman of the Manchester Institution of Electrical Engineers, devoted his opening address on October 28 to observations on a recent visit to the United States. Mr. Peck is the first American to take the chairman's office at any English electrical section, and he discussed what he saw in America in order to show wherein it contained object lessons for British electrical manufacturers who were all complaining of the state of their business, while the electrical trade of the States was flourishing. He was most of all impressed by the quantity of standard machines which were being manufactured and the great advances made in electric traction. One thing he said was as follows: While the greater part of the large electrical machinery work, and practically all the electric railway work, was done by either the General Electric or Westinghouse companies, there was the keenest engineering competition between them As a result, they strove not only for the improvement of shop methods but for advances in the electrical and mechanical design of their apparatus and the development of new and improved types. This engineering rivalry was shown by the keenness of the discussions at the Institute meetings, and if one of the companies brought out a new type of machine, and, as was usually the case, described it in a paper before the Institute, the engineers of the other company were certain to point out its defects so emphatically that a machine or system of faulty or inadequate design had little chance of making much progress. The prosperous condition of such companies enabled them to carry large engineering staffs, and support research and experimental laboratories, and to undertake the development of new lines of apparatus and of new electrical schemes, on a scale quite impossible for the manufacturers of England.

Without expressing any opinion upon the value of a tariff on electrical goods coming into this country, he said that tariffs had undoubtedly helped the American electrical engineer, but he also gave other reasons of a more domestic character. Municipal control did not exist to the same degree in the States as in England, and the greater daring of American business men was referred to as an important factor.

Technical education, and absence of Government restrictions also played their part, according to Mr. Peck, and Americans are more ready to scrap old apparatus and substitute the latest improvements.

Not Even a Sou!

The *Edison Round Table*, the bright little monthly published by the Commonwealth Edison (Chicago) Branch of the National Electric Light Association, seeking for a slogan on the lines of "Only a penny and better than any," adopted by a well known Chicago daily newspaper, has hit upon "Not even a sou, but read through and through."

Gas and Electric Meter Tests.

Of the 208 gas meters tested on complaint by the Public Service Commission of New York during October, 55.8 per cent were found to be fast and 6.2 per cent were slow. Of twenty-eight electric meters tested during the same period, one was found to be fast and one slow.

LETTERS TO THE EDITOR.

Storage-Battery Work of Brush.

To the Editor:

I note that the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN for October 8 contains a brief biographical sketch of the writer. The article as published is correct in the main, but it does scant justice to my storage-battery work. In the interest of historical accuracy I beg to submit the following statement:

My fundamental storage-battery patent No. 337299 of March 2, 1886, was regarded as one of the broadest patents ever issued by the Patent Office, and was obtained after years of interference litigation, so that all the facts bearing on the subject were fully threshed out. Subsequently this patent was repeatedly sustained in its broadest sense by the federal courts. It was fundamental in scope, and covered all practical forms of storage batteries, and controlled this field until its expiration, in 1903.

It is a curious fact that while I am the inventor of the practical storage battery beyond a doubt, my name is never connected with it. Perhaps this is because I leased out on royalty this branch of my electrical interests at an early date to former competitors, who naturally did not connect my name with their subsequent manufactures.

Cleveland, O. C. F. BRUSH.

Esperanto in Technical Correspondence.

To the Editor:

In view of the increasing interest that many Americans are taking in the auxiliary international language, "Esperanto," I thought that a brief description of the "Sixth International Congress," held at Washington, D. C., from August 13 to August 20, might be *apropos*.

On August 13 the parlor car between Pittsburg and Washington was well-nigh filled with a jolly and sociable company of Esperantists, who talked now in English, now in Esperanto about the coming Congress. Every "first-timer" wonders whether conversation with a foreigner entirely in Esperanto will be mutually understandable.

And so amidst excitement and conjecture we arrived and were greeted by an Esperantist, carrying the flag, who in clear and perfectly comprehensible Esperanto directed us to our hotels and to the headquarters of the Congress. Shortly afterwards we were attending the first informal reception, where we met Dr. L. L. Zamenhof, the inventor of the language, and a number of celebrities from abroad. Then amidst the greatest enthusiasm Dr. Zamenhof made some felicitous remarks, which were followed by short talks of a like nature by persons of various nationalities. Before the evening was over we began to realize that nationality is no barrier to comprehensibility, and after the practice of several days we found ourselves conversing freely with persons of various lands who knew no English. Maturer reflection shows that such should be the case, because Esperanto is a perfectly phonetic language. A strong national brogue, combined with inarticulateness, might make comprehension difficult, but only because one's ears have not had sufficient practice to grasp readily the sounds and meaning.

It has never been my privilege to meet at one time so many persons of national distinction and strong mental attainments. There were: Josefo Perogordo, of the Spanish army and personal representative of King Alfonso; Aleksandro Postnikof, the official representative of the Russian Government; in all, there were eleven official representatives, showing a strong gain over the three at last year's Congress. Besides these, may be mentioned: Maurice Rollet de l'Isle, hydrographic engineer, chief of the French Marine, who is doing much towards the development of Esperanto along scientific lines; Professor A. Cotton, physicist of the University of Paris, etc., and many noted educators of this country.

The Esperanto Congress badge was considered sufficient for an introduction, and both at the regular meeting and elsewhere there was manifested a feeling of fellowship and good will.

In addition to the regular official work of the Congress, which consisted of reports from the official delegates and from the standing committees to which is entrusted the development of Esperanto, there were meetings by members of other organizations where Esperanto was used. Amongst these may be mentioned jurists, physicians, railroads, engineers, nurses, journalists, free thoughters, Catholic Union, Theosophists, financiers, post-office officials, vegetarians, teachers and persons interested in the Peace movement. The members of these various beliefs and organizations intermingled and harmony prevailed, which illustrates the idealistic side of the movement. Returning to the more practical side, the reports from different parts of the world showed substantial progress during the last year. In Europe, Esperanto is being taught officially in many schools. In this country, the State of Maryland has passed a law introducing Esperanto into its schools. In England, France and in some other countries several large companies are using Esperanto entirely in their foreign correspondence. In Brazil, Esperanto is being used for commercial purposes. Aside from this, interesting accounts were given where Esperanto was used by travelers abroad, and had not only been of great help but had also been the means of making some very desirable friendships.

So we all returned very much pleased with our experience and fully believing that in Esperanto is found a help language which is thoroughly practical and which is being recognized more and more from year to year. Anyone interested in a more detailed account of the Congress should write to E. C. Reed, Secretary Esperanto Association of North America, Chamber of Commerce, Washington, D. C.

Pittsburg, Pa. H. W. FISHER.

[Mr. Fisher, who is chief engineer of the Standard Underground Cable Company, is an ardent Esperantist and President of the Pittsburg Esperanto Society. He informs us that considerable use is already being made of Esperanto in technical and business correspondence. Mr. Fisher is well known in the electrical field as a masterful and scholarly contributor to technical literature and his communication is commended to all interested in this department of language culture.—ED.]

Electrical Generating Stations in Bavaria.

A recent inquiry into the ownership of the electrical generating stations in Bavaria shows that 1,620 are privately owned, 374 are run by limited-liability companies, and 500 are controlled by the Government, municipalities, and co-operative societies. The total output is 275,472 kilowatts. About 47 per cent of the plants are steam-driven, 30 per cent are driven by water power and steam, and 8 per cent by water power.

SOME TYPES OF CIRCUITS FOR VOLTAGE, CURRENT AND POWER CONTROL.—I.

STEP-BY-STEP TRANSFORMER CIRCUITS.

BY CLARENCE I. ZIMMERMAN.

The modern method of developing electric power by standard-type alternating-current machines of enormous capacity and of utilizing this power for the most varied purposes necessitates the introduction of voltage, current and power-controlling or regulating devices in many places where, if the generator were supplying a single load only, these regulating devices would not be necessary.

Leaving out of consideration the method of using a variable series resistance, we may classify alternating-current regulators as: (1) The Step-by-Step Transformer Regulators; (2) The Induction Regulators; (3) The Reactance Regulators. Regulators may also be built which include two or even three of the distinctive features in this classification.

It is to a diagrammatic study of the first of these classes that this article will be confined.

In the second class of regulators, the single-phase induction regulator consists of a transformer whose primary coil is in shunt with the line and whose secondary coil is in series with the line and one of the two coils is moved so that their separate magnetic fields react upon one another to a varying extent. The polyphase induction regulator is similar to an induction motor in appearance and consists of a transformer whose secondary turns, which are in series with the line, have constant voltages induced in them by the primary or shunt coils, the secondary voltages being displaced by variable phase relations from the primary voltages.

The third class, or reactance regulators, depend upon variable amounts of reactive or 'choking' effects which may be obtained in many ways, such as, (1) by means of a coil having a variable magnetic leakage, or (2) by varying the number of turns of a reactive coil, or (3) by moving an iron core in a reactance coil, or (4) by magnetizing the core of a reactive coil with a variable unidirectional current, or (5) by the interaction of two alternating magnetic fields which are displaced in their phase relations.

NOTES ON THE CIRCUIT DIAGRAMS.

The step-by-step method may be used with coils of all kinds, but is used particularly with shunt transformers, shunt auto-transformers, series transformers, and series auto-transformers. These are shown in Figs. 1 to 5A.

When the voltage or current to be transformed is to suffer only a slight increase or decrease, auto-transformers may be used which at first sight may appear to be distinctively different from the plain shunt or series auto-transformers. They have both shunt and series coils, but a brief consideration will make it evident that they are only limiting cases of auto-transformers. These are shown in Figs. 5 and 5A.

In all of the diagrams the transferring of the lead from one point to another is supposed to take place without interruption of the main current flow. In practice this can be accomplished by the aid of a transfer-resistance or a transfer-coil. In the second part of this article these methods of transferring the current from one tap to another will be more fully considered. This matter is of considerable importance because the life of the switch contacts is often very materially affected by a phenomenon which is not apparent from a casual study of the circuits.

Current transformers are at present used chiefly in connection with meters and switchboard instruments but they have been used in connection with high-power electric arc furnaces and will be used for this purpose to a much greater extent in the future.

These step-by-step methods may be adapted to polyphase circuits for voltage regulation or for phase displacement, or for both of these purposes. They are also applicable to certain kinds of reactance regulators which involve a change in the number of reacting turns.

With the exception of the circuit shown in Fig. 9 and those following Fig. 31, there is only one magnetic core present. The coils are in all cases supposed to be so placed on the core as to give the minimum magnetic leakage between the turns carrying the primary and the secondary current.

Where two movable points connect with the same continuous coil, as in Fig. 13, they can be made to operate by one handle and so that they operate alternately. The magnetic distribution in these schemes may in some cases be a considerable improvement over the others.

The reversing switches are supposed to be operated only when there is practically no current flowing in them, and in certain cases only when they are short-circuited. These short-circuiting switches are to be operated only when the portions of the transformers which they bridge do not consume or deliver power.

Fig. 1. Shunt Transformer.—The arrows represent the momentary directions of current flow when the polarity of the alternating pressure is as is indicated.

Fig. 2. Shunt Auto-Transformer.—When the number of low-voltage turns is one-half the high-voltage turns, the current in the low-voltage side is approximately twice the current in the high-voltage side, but the currents in the two parts of the coil itself are practically equal.

Fig. 3. Series Transformer.—Used on constant-current circuits. The current in the secondary is constant, but the voltage varies with the resistance of the load. The upper limit of the voltage across the terminals of the secondary coils is that induced by the transformer core when it is saturated with magnetism. The secondary may be short-circuited without any appreciable increase of current.

Fig. 4. Series Auto-transformer.—For use on constant-current circuits. In the circuit shown, the current through the load will be approximately twice the current in the primary turns. Where complete insulation of primary and secondary circuits is required, this type cannot be used.

Fig. 5. Shunt Auto-transformer.—For comparatively small amounts of positive or negative voltage boosting. The shunt turns are designed to determine the maximum magnetic saturation of the transformer core. This type forms the basis for regulators of the Stillwell type for the regulation of constant-potential feeders.

Fig. 5A. Series Auto-transformer.—For comparatively small amounts of positive or negative current boosting on a constant-current circuit. The variable voltage across the shunt turns determines the degree of magnetization in the transformer core. This forms the basis for a type of regulator for

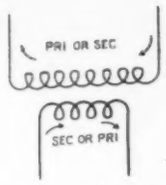


FIG 1 - SHUNT TRANSFORMER

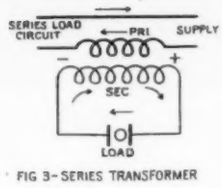


FIG 3 - SERIES TRANSFORMER

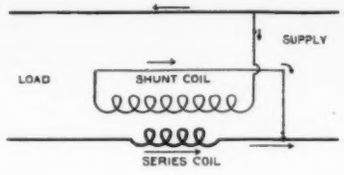


FIG 5 - SHUNT AUTO-TRANSFORMER

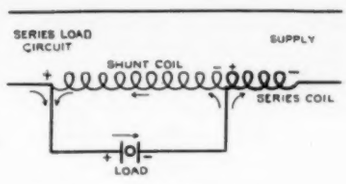


FIG 5A - SERIES AUTO-TRANSFORMER

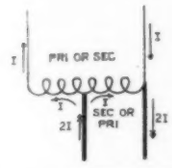


FIG 2 - SHUNT AUTO-TRANSFORMER

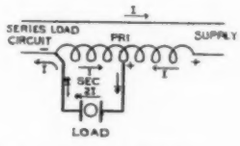


FIG 4 - SERIES AUTO-TRANSFORMER

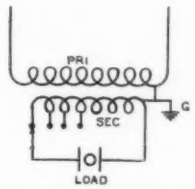


FIG 6 - SHUNT TRANSFORMER

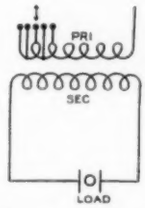


FIG 7 - SHUNT TRANSFORMER

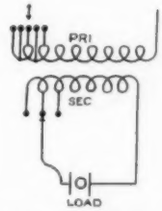


FIG 8 - SHUNT TRANSFORMER

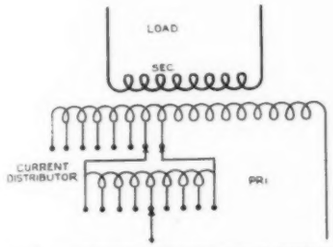


FIG 9 - SHUNT TRANSFORMER WITH CURRENT DISTRIBUTOR

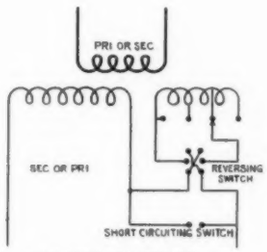


FIG 11 - SHUNT TRANSFORMER

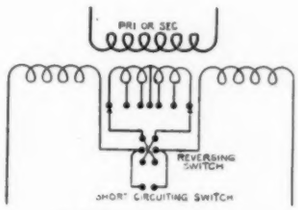


FIG 13 - SHUNT TRANSFORMER

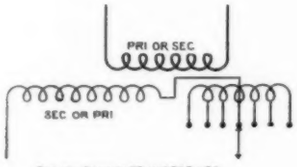


FIG 10 - SHUNT TRANSFORMER

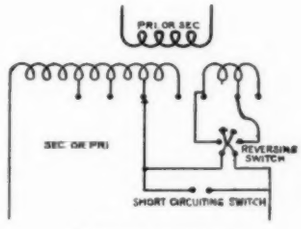


FIG 12 - SHUNT TRANSFORMER

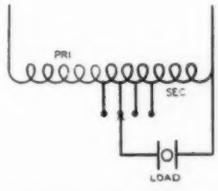


FIG 14 - SHUNT AUTO-TRANSFORMER

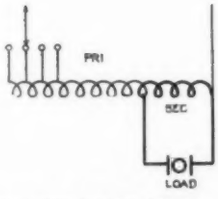


FIG 15 - SHUNT AUTO-TRANSFORMER

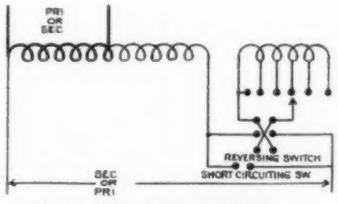


FIG 17 - SHUNT AUTO-TRANSFORMER

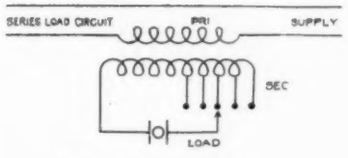


FIG 19 - SERIES TRANSFORMER

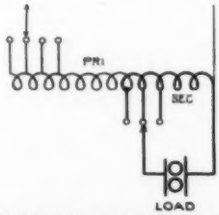


FIG 16 - SHUNT AUTO-TRANSFORMER

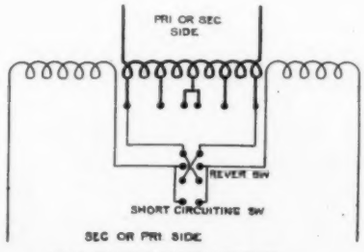


FIG 18 - SHUNT AUTO-TRANSFORMER

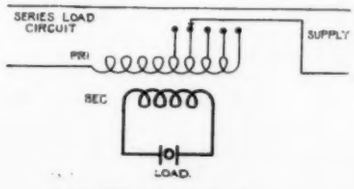


FIG 20 - SERIES TRANSFORMER

TYPES OF CIRCUITS FOR VOLTAGE, CURRENT AND POWER CONTROL.

constant-current circuits where the currents in the individual load circuits are only slightly different from the currents in the main series load circuit. A regulator based on this type is to the constant-current circuit what the Stillwell regulator is to the constant-voltage circuit. These coils transform only the quantity of power boosted.

Fig. 6. Shunt Transformer with Variable Secondary Turns.—This is a common type used for variable voltage requirements. It is used on some single-phase railways, but the primary and the secondary coils may be connected at one end and grounded as shown by the dotted line.

Fig. 7. Shunt Transformer with Variable Primary Turns.—Used where very heavy secondary currents are required, as in electric-furnace work. The maximum magnetization value of the transformer core is increased when the number of turns on the primary coil is decreased. In Fig. 6, the maximum magnetization of the core is constant for all loads.

Fig. 8. Shunt Transformer with both the Primary and Secondary Turns Variable.—The changing of the secondary turns gives coarse regulation, and the changing of the turns on the primary gives the finer and more frequently used regulation of the secondary voltage.

Fig. 9. Shunt Transformer with an Auxiliary Current Distributor.—The number of turns is varied on the primary side. The current distributor is an auto-transformer. This type is used for very fine regulation of voltage, current, or power where very heavy secondary currents are required.

Fig. 10. Shunt Transformer.—An extra coil called the regulator coil is used in series with the main coil. The magnetizing effect is either additive or subtractive.

Fig. 11. Shunt Transformer.—This circuit performs the same service as that shown in Fig. 10, but the windings and the number of the taps coming from the transformer are simpler.

Fig. 12. Shunt Transformer.—Similar to Fig. 11, but with wider range of voltage variations.

Fig. 13. Shunt Transformer.—Two movable points make contacts with transformer taps. This scheme allows a slightly better magnetic distribution to be made than by the previous circuits. The two contact shifters are moved alternately until they reach the center. The short-circuiting switch is closed, the reversing switch thrown over and the short-circuiting switch opened again. Then the contact shifters are moved apart and the magnetizing effect of the auxiliary coil is opposed to what it was before.

Fig. 14. Shunt Auto-transformer.—Secondary turns are variable. This is used on some single-phase railways.

Fig. 15. Shunt Auto-transformer.—Variable turns are on the primary.

Fig. 16. Shunt Auto-transformer.—The variable primary turns in this circuit give the fine regulation, while the secondary turns give the coarse regulation.

Fig. 17. Shunt Auto-transformer.—See Fig. 11.

Fig. 18. Shunt Auto-transformer.—Two movable contacts are here used. See Fig. 13. The polarity of the potential induced in the middle coil is independent of the position of the reversing switch, since the magnetism is that determined by the main coils.

Fig. 19. Series Transformer.—The secondary turns are variable. The fewer the turns in the secondary, the greater is the current in the secondary.

Fig. 20. Series Transformer.—The primary turns are variable. The fewer the turns on the primary, the smaller is the current in the secondary.

Fig. 21. Series Transformer.—Both the primary and the secondary turns are variable. They can be so proportioned that the primary gives fine adjustments of current, while the secondary gives coarse adjustments.

Fig. 22. Series Transformer.—The primary turns are variable and an extra coil is used for fine regulation. This control may be used on the secondary instead of on the primary side.

Fig. 23. Series Transformer.—This circuit is similar to Fig. 22, but fewer transformer taps and coils are needed. See Fig. 12.

Fig. 24. Series Auto-transformer.—Secondary turns are variable. See Fig. 19.

Fig. 25. Series Auto-transformer.—Primary turns are variable. See Fig. 20.

Fig. 26. Series Auto-transformer.—Primary turns are variable for both fine and coarse current control. This regulation may be done on the secondary instead of on the primary side by a similarly arranged circuit.

Fig. 27. Series Auto-transformer.—This circuit uses the double contact shifting scheme described with Fig. 13.

Fig. 28. Regulator, Stillwell Type.—This is largely used for feeder regulation. It is a transformer with shunt and series coils and has a variable number of turns in the series coils. It is an auto-transformer of the shunt type. See Fig. 5.

Fig. 29. Regulator, Kapp Type.—A positive or negative booster suitable especially for heavy currents. This has a variable number of shunt turns instead of the variable series turns in the Stillwell type. In both the Stillwell and the Kapp regulators there is a constant electromotive force induced in the secondary turns (when no changes in the transformation ratio are being made). This electromotive force is independent of the current in the series turns. The current in the primary varies with that in the secondary.

Fig. 30. Regulator.—For coarse and fine regulation. The series steps give regulation, while the shunt steps give the finer regulation.

Fig. 31. Regulator.—See Figs. 13, 18 and 27.

Fig. 32. System of Regulation, Lamme.—Two transformers, in one of which three coils are used, give the control. When there is a varying current in the line due to a change in the load, the current in coils 3 and 4 will change, but the electromotive force induced in the turns of coil 3 is constant.

Fig. 33. System of Regulation.—Two transformers; the two extra coils for control. See Fig. 32.

Fig. 34. System of Regulation.—Two transformers using the two-point-contact-shifting scheme to give the control.

Fig. 35. System of Regulation, Westinghouse.—There are shown two transformers, one a shunt auto-transformer and the other a transformer which has one series coil and one coil which may be considered to be either a shunt or a series coil. Used in heavy current control.

Fig. 36. System of Feeder Regulation, Stanley.—Auto-transformers are used on each feeder. They obtain their terminal voltage from one end of the main generator coil and a secondary tap at a short distance from this tap. The generator coil with the auxiliary tap may be replaced by the secondary of a transformer with an auxiliary tap.

(To be continued.)

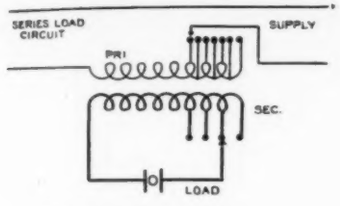


FIG 21-SERIES TRANSFORMER

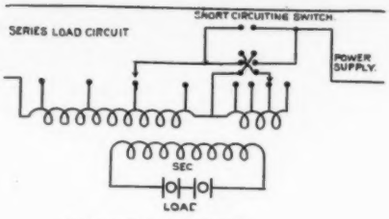


FIG 23-SERIES TRANSFORMER

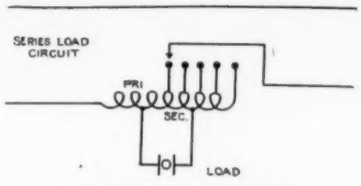


FIG 25-SERIES AUTO-TRANSFORMER

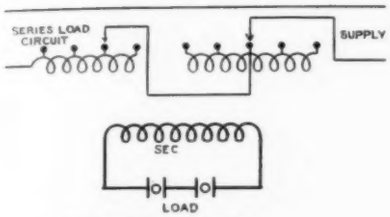


FIG 22-SERIES TRANSFORMER

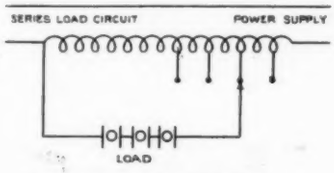


FIG 24-SERIES AUTO-TRANSFORMER

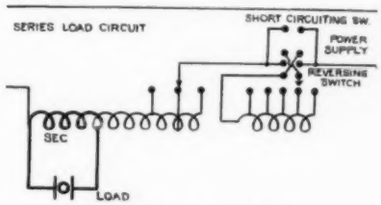


FIG 26-SERIES AUTO-TRANSFORMER

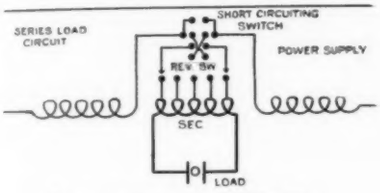


FIG 27-SERIES AUTO-TRANSFORMER

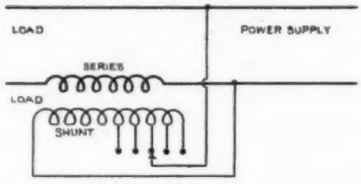


FIG 29-REGULATOR-KAPP TYPE

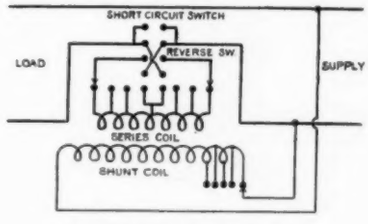


FIG 31-REGULATOR-STILLWELL-KAPP

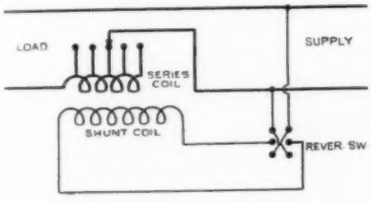


FIG 28-REGULATOR-STILLWELL TYPE

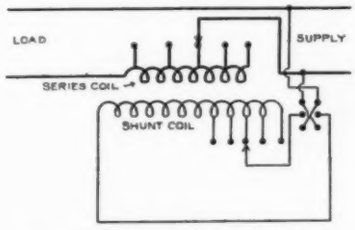


FIG 30-FEEDER REGULATOR-STILLWELL-KAPP

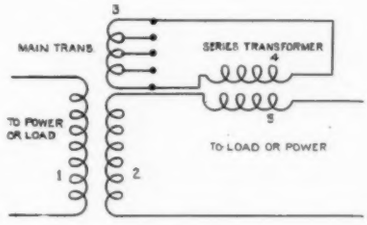


FIG 32-SYSTEM OF REGULATION-LAMME

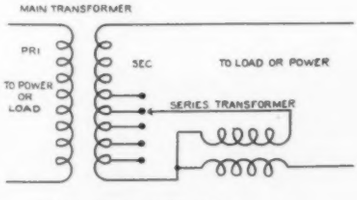


FIG 33-SYSTEM OF REGULATION

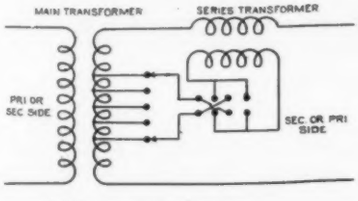


FIG 34-SYSTEM OF REGULATION

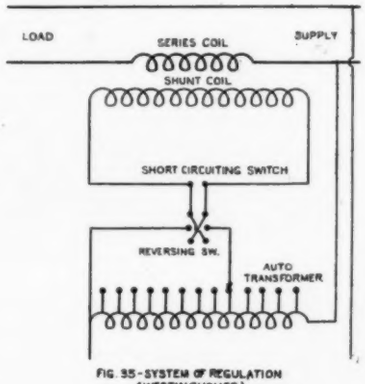


FIG 35-SYSTEM OF REGULATION (WESTINGHOUSE)

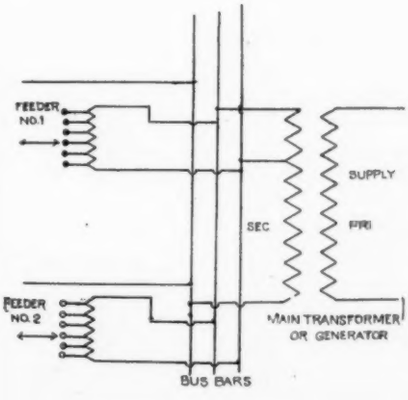


FIG 36-SYSTEM OF FEEDER REGULATION (STANLEY)

TYPES OF CIRCUITS FOR VOLTAGE, CURRENT AND POWER CONTROL.

The New Engineering Headquarters of the National Electric Lamp Association.

The 1910 census has disclosed not only the fact that all of our large American cities are growing, but that certain of them are growing by leaps and bounds, forging past their neighbors and breaking into the front ranks of size and commercial importance. In the latter group Cleveland, with its five-hundred-sixty-and-odd thousands of population, and its proposed slogan, "Cleveland One Million by Nineteen Twenty," must certainly be reckoned. Nor does that slogan represent a mere flight of fancy. New industrial enterprises and factories are springing up with mushroom-like rapidity, and each one adds a new company to the army of workers. Only the other day the formation of the "Detroit and Cleveland Aero Company," whose airships may soon be plying between Cleveland and Michigan's metropolis, leaked out through the daily papers.

Decidedly less "flighty" considerations, however, led to the erection of the new quarter-million dollar building on Hough Avenue, Cleveland, where the engineering department of the National Electric Lamp Association now conducts its activities. A growth more phenomenal—if it should really be called phenomenal at all—than that of any American city has marked the progress of the incandescent-lamp industry for the last decade, and the officers of that particular group of manufacturers which forms the National Electric Lamp Association discovered several years ago that the expansion of the Association's engineering activities necessitated by this rapid growth would soon compel them to "tear down their barns and build greater." Accordingly, the old Engineering Department Building, which had, in earlier days, formed part of the Brush Electric Company's plant, was demolished, and work was started in August, 1909, on the three-story brick and steel structure shown in Fig. 1.

Plenty of daylight is admitted to the offices and laboratories by means of upwards of 300 windows, 265 of which are located in the four outer walls, while the remainder face on two large rectangular inner courts.

The Engineering Building has nearly three acres of floor space, on five floors. The work being conducted on each floor may be summarized as follows:

1. *Basement.*—Electrical generating and converting machinery, including a 200-kilowatt, sixty-cycle revolving-field alternator. Control apparatus, mainly located on the forty-foot slate switchboard. Blue-print rooms, with automatic are blue-printing machine. Instrument calibrating room. Lunch room. Kitchen. Store-rooms.

2. *Main floor.*—Offices of the chief engineer and of the manager and assistant manager of the Engineering Department. Executive offices. Stenographers' office. Technical-publicity office, where test results and technical data on lamps and illumination are compiled and indexed for reference. Commercial engineering. Economic research, including the investigation of characteristic performance exponents for incandescent-lamp filaments, and the study of the incandescent lamp in its complicated bearings on central-station economics, public policy, and rates. Technical library.

3. *Second floor.*—Illuminating engineering, including the preparation of illumination plans and specifications for customers of any of the several member companies, upon request of the latter. Testing, including the proper "volting" of lamps for performance tests, vacuum and base-testing of sample lamps, distribution photometry of lamps and reflector units, etc. Inspection Bureau. A branch of the Physical Research Laboratory of the National Electric Lamp Association, described in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN for September 10, also has rooms on this floor.

4. *Third floor.*—Special investigations and tests. An auditorium, sixty by forty-eight feet, with lecture platform and projecting lantern, for lectures, demonstrations and large meetings.

FIG. 1.—THE NEW ENGINEERING LABORATORIES OF THE NATIONAL ELECTRIC LAMP ASSOCIATION.

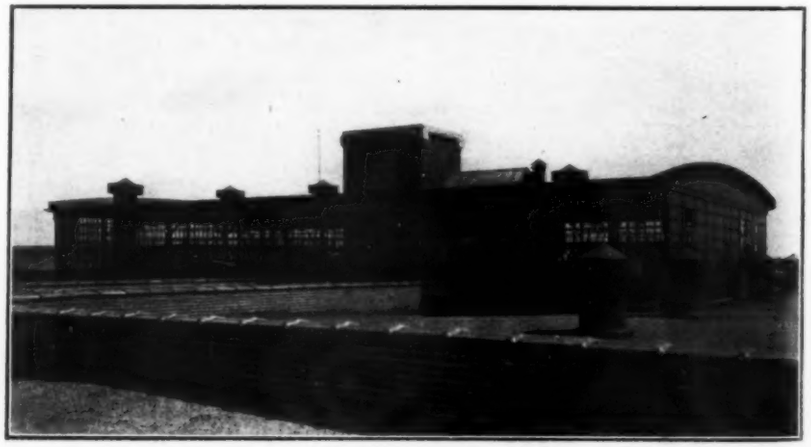


FIG. 2.—TEST-RACK ROOM ON ROOF.

5. *Glass-walled Compartment on the Roof (See Fig. 2).*—Approximately 2,300 lamps are here tested every month for performance throughout life. These lamps are taken from the regular output of the member companies and are burned day and night in order that the manufacturers may make sure, by the average test results so obtained, that quality is being maintained and improved.

FIG. 3.—THE LUNCH ROOM.

FIG. 4.—THE KITCHEN.

The above outline of the work to which the various parts of the new building are devoted is necessarily very brief. As an outline of the engineering and scientific activities of the Association, it fails entirely to cover the ground, since the lamp development, filament development and chemical and physical research laboratories are not located in the Engineering Building.

The entrances are illuminated at night by means of fixtures of lantern design, each containing four sixty-watt Mazda lamps. For interior lighting, Mazda lamps, mainly of the 150-watt size are used throughout, and are equipped with Holophane prismatic glass reflectors for proper distribution.

Nearly all of the younger technical men connected with the Engineering Department are college graduates and the spirit of good-fellowship and cooperation existing among them is very marked. It is one of the policies of the Association to foster, rather than to suppress, such a spirit, and one of the many influences in this direction is the lunch room referred to above and illustrated in Fig. 3. Here the men of the Engineering and other departments gather in groups for the noon meal, exchange ideas on their work, and finally come to form intimate acquaintanceships with one another. Thus the lunch room is not only a convenience, but also a sort of informal clearing house for ideas and experiences.

People sometimes ask "Is an elaborate engineering department necessary for the manufacture of lamps?" Insert the word "successful" before "manufacture," and the answer must be in the affirmative. The art of incandescent-lamp manufacture consists in much more than merely sealing a filament into a bulb and then pumping out the air. The service that a lamp will give depends upon, and is radically affected by, hundreds of apparently minor details connected with the choice of materials or processes. A good lamp and a "five-hour burnout" may, when new, look absolutely alike to any one but an expert. How then are the interests of the consumer, the central station, the jobber, the distributor and the contractor to be protected from injuries due to lack of quality and ignorance of lamp performance? Proper engineering facilities, provided by the manufacturers, are the only safeguards. And the new Engineering Building of the National Electric Lamp Association is the result of frank recognition of this fact by a group of the lamp manufacturers themselves.

The effect upon the entire industry cannot be other than beneficial.

Power Developments in Mexico.

The eighty-nine-mile transmission line from Guanajuato, Mexico, to San Luis Potosi, says *The Mining World*, has been completed by the Central Mexico Light and Power Company, a subsidiary of the Guanajuato Power and Electric Company. The generating plant in the state of Michoacan is over 100 miles from Guanajuato, and the total transmission will be nearly 200 miles. Some months ago the Company purchased the San Luis Potosi power plant and distributing system for $700,000. The new line is now delivering power to the rich Providencia San Juan de la Luz mines at San Felipe.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

NOVEMBER MEETING AT NEW YORK.

The two hundred and fifty-third meeting of the American Institute of Electrical Engineers was held in the Engineering Societies' Building, New York City, on the evening of November 11, with President D. C. Jackson in the chair. Secretary Pope announced that the Board of Directors had just elected forty-two Associates and that the following Associates had been transferred to the grade of Member:

Joseph H. Libby, Boston, Mass.; Lewis L. Holliday, Charlotte, Va.; William M. Mutter, Milwaukee, Wis.; Clark T. Henderson, Milwaukee, Wis.; Clarence E. Dooley, Colorado, and Olin Jerome Ferguson, Schenectady, N. Y.

The topic of the evening was "Interpoles in Synchronous Converters," this being the title of a paper by B. G. Lamme and F. D. Newbury. The paper was presented in abstract by Mr. Newbury.

INTERPOLES IN SYNCHRONOUS CONVERTERS.

The authors first comment on the fact that interpoles are not much used on rotaries in this country, although extensively employed abroad. For direct-current generators and motors interpoles are commonly used here, especially for railway motors and high-speed dynamos. This is due to the greater value of interpoles on these machines than on rotary converters. A brief discussion of the good effects of an interpole construction on commutation in direct-current machines is given. The use of interpoles also permits greater leeway in designing the armature winding. A synchronous converter, however, differs considerably from a direct-current generator, because it is also at the same time an alternating-current motor. The magnetomotive force of the armature winding as a motor acts in one direction, while that as a generator acts in the opposite direction. These two magnetomotive forces, therefore, practically neutralize each other; the resultant or effective magnetomotive force in any case is not over one-fifth of that as a direct-current generator. Consequently commutation of a synchronous converter is not nearly as troublesome as in a direct-current generator. If interpoles are used on the converter they would be only twenty-five to forty per cent as large as on a direct-current generator. The pulsating resultant magnetomotive force in the converter would tend to cause trouble, but it is of relatively high frequency and, therefore, dumps itself out without any noticeable harmful effects in a well designed machine. The magnetic leakage from interpoles is more troublesome. Shunting of the interpole current is needed in some instances, but a non-inductive shunt is not serviceable with sudden load fluctuations; for a railway machine an inductive shunt should be used. The authors then consider overload conditions, such as sudden short-circuit, and find that in the case of a converter the presence of interpoles may cause serious trouble due to overbalancing of their ampere turns and therefore the conversion of the interpoles into paths for the excessive armature flux then developed. A short circuit on the direct-current end, opening the circuit-breakers there, would not reduce the electromotive force, since the converter would still be connected to the alternating-current supply. Hunting also would greatly complicate matters and make interpoles of little useful value, if not a positive detriment. The authors then take up the four most common types of converters, namely, twenty-five-cycle 250 and 600-volt machines and fifty-cycle 250 and 600-volt machines, considering in each case the features that limit the design and particularly the possibility of increased speed and effect of interpole construction. Their opinion is that the 600-volt machines offer the most promising field for the use of interpoles and that the 250-volt machines would probably not be improved in design. Summarizing their conclusions, the advantages of interpoles with higher speeds would be: Possible reduction in cost, less attention required in operation, and longer life of commutator and brushes. The disadvantages, however, would be: Possible increased trouble from "bucking" on sudden load changes or short circuits, possibly reduced efficiency, higher operating temperatures. If increased speed was not possible, the advantages would be diminished, the disadvantages increased, and refinement in design at greater original cost would seem to be the only result.

Gano Dunn opened the discussion by calling attention to the clear and forcible manner in which the authors had presented the subject. The use of interpoles is not new. They accomplish what is known as magnetic commutation. In many cases where they have been used the principle of resistance commutation could well have been extended a little further and accomplish as good results with no increased cost of the machine or reduced efficiency. Mr. Dunn referred at some length to the method devised by F. W. Young of placing a "dead" brush adjacent to the "live" one so as to obtain a somewhat higher counter electromotive force at the heel of the latter. This method is particularly valuable for higher-voltage rotaries.

H. F. T. Urban said that, while he agreed with the general conclusions of the paper, he believed the authors had not pointed out the greatest field of usefulness for interpoles on rotaries. This is on machines for voltages from 1,000 to 1,500 and also for 600-volt rotaries in intermittent service such as in interurban substations, where the load suddenly changes from zero to as much as four times the rated load. The rotaries principally referred to in the paper were those suited to large central-station systems where heating limits the design much more than commutation does. Much experimenting had been done by him on interpole rotaries and it was found that if the interpoles are properly designed no bucking or flashing results even on continued heavy short circuits. A machine that is properly designed will not flash over with six or even eight times normal load, regardless of whether it has interpoles or compensating windings or not. Mr. Urban believed that an inductive shunt can easily be designed with a time constant that would not make it detrimental when a heavy load is suddenly thrown off. He had experimented with several designs and could readily control the current in the commutating field.

Dr. Chas. P. Steinmetz concurred in the authors' conclusions as regards central-station rotaries, but he also agreed with the previous speaker on the value of interpoles for rotaries in interurban railway service. In this service 1,200 volts is becoming common and even 2,400 volts direct current is possible with interpole machines. The average load being low and the sudden overloads enormous, a relatively small machine with capacity for handling such overloads is desirable, as its load factor and efficiency would be improved and its liability to hunting decreased because of its diminished momentum. Theoretically flashing over would result with such machines, but practically it does not occur.

P. M. Lincoln read a communication on the subject from Mr. Bache-Wiig, in which the latter advocated interconnecting the direct-current and alternating-current circuit-breakers so that in case of a short circuit on the direct-current end, flashing over may be prevented. This is particularly desirable with interpole converters, as the damage from flashing is liable to be severe. current end flashing over may be provided with effective dampers to prevent hunting. For his own part Mr. Lincoln not only indorsed the opinions of the authors of the paper, but called attention to the inability of employing the split-pole principle on converters provided with commutating poles.

J. L. Burnham narrated the results of some experiments made with a twenty-five-cycle, 1,200-volt rotary in which it was found that the addition of a narrow interpole with large air gap made it possible to secure four times the load from the rotary without sparking as was possible before the interpoles were added.

C. W. Stone agreed with Dr. Steinmetz in assigning the greatest field of usefulness of interpoles on rotaries to those machines for interurban substations where very heavy momentary overloads are met.

Prof. C. A. Adams briefly commented on the value to students of presenting such a subject without a mass of mathematical expressions.

B. G. Lamme closed the discussion by answering a number of critics of his paper and by expanding certain of his conclusions. With regard to interurban railway converters, he stated that these usually do not exceed 300 or 400 kilowatts and in such machines commutation is more favorable than in large rotaries because the output per pole is relatively small. It is not difficult to carry four times rated load without sparking in a well designed machine of this type. In 1,500-volt rotaries the limiting feature is too small a width of commutator bar and not the commutation proper. However, for intermittent service the interpole machine doubtless will prove of great value. In some cases rotaries are built with only half as many interpoles as main poles; this gives better ventilation, reduces the magnetic leakage and improves the efficiency. It is also possible to reduce the width of the interpole and make it less than the length of the armature. In regard to the use of copper dampers on rotaries, Mr. Lamme showed that the ideal damper for hunting is not a suitable one for use with interpoles, but by splitting the damper winding into sections this difficulty would be overcome. He pointed out the difficulty from heating of the coils connected to the collector rings and also discussed the difference between the split-pole and interpole converters. In conclusion he stated that at present there did not seem much need for interpoles on rotary converters, but that as their speeds went up this need will become more urgent.

Directory of Colleges and Technical Schools Giving Courses in Electrical Engineering, With Name of Professor in Charge.

NAME.	ADDRESS.	PROFESSOR.
University of Maine	Orono, Me.	Walter K. Ganong.
New Hampshire College	Durham, N. H.	Charles E. Hewitt.
Dartmouth College	Hanover, N. H.	Frank E. Austin.
University of Vermont and State Agricultural College	Burlington, Vt.	William H. Freedman.
Massachusetts Institute of Technology	Boston, Mass.	D. C. Jackson.
Harvard University	Cambridge, Mass.	A. E. Kennelly.
Tufts College	Tufts College, Mass.	William L. Hooper.
Worcester Polytechnic Institute	Worcester, Mass.	Harold B. Smith.
Brown University	Providence, R. I.	Arthur E. Watson.
Rhode Island State College	Kingston, R. I.	Leonard P. Dickinson.
Yale University	New Haven, Conn.	C. S. Hastings.
New York University	New York, N. Y.	J. Loring Arnold.
Columbia University	New York, N. Y.	F. B. Crocker.
Cooper Union	New York, N. Y.	F. M. Hartmann.
Polytechnic Institute	Brooklyn, N. Y.	Samuel Sheldon.
Pratt Institute	Brooklyn, N. Y.	S. S. Edmands.
Rensselaer Polytechnic Institute	Troy, N. Y.	E. D. N. Schulte.
Union University	Schenectady, N. Y.	E. E. F. Creighton.
Cornell University	Ithaca, N. Y.	H. H. Norris.
Syracuse University	Syracuse, N. Y.	W. P. Graham.
Clarkson Memorial School of Technology	Potsdam, N. Y.	A. M. Buck.
Stevens Institute of Technology	Hoboken, N. J.	A. F. Ganz.
Rutgers College	New Brunswick, N. J.	F. F. Thompson.
Princeton University	Princeton, N. J.	C. F. Brackett.
Lafayette College	Easton, Pa.	James T. Rood.
Lehigh University	South Bethlehem, Pa.	William Esty.
University of Pennsylvania	Philadelphia, Pa.	W. E. S. Temple.
Drexel Institute	Philadelphia, Pa.	Arthur J. Rowland.
Swarthmore College	Swarthmore, Pa.	George A. Hoadley.
Bucknell University	Lewisburg, Pa.	F. M. Simpson.
Pennsylvania State College	State College, Pa.	John P. Jackson.
University of Pittsburg	Pittsburg, Pa.	E. J. K. Mason.
Carnegie Institute	Pittsburg, Pa.	A. J. Wurts.
Delaware College	Newark, Del.	L. A. Freudenberger.
Johns Hopkins University	Baltimore, Md.	John B. Whitehead.
Maryland Agricultural College	College Park, Md.	Myron Creese.
George Washington University	Washington, D. C.	Philander Betts.[1]
Catholic University of America	Washington, D. C.	George F. Harbin.
University of Virginia	Charlottesville, Va.	W. S. Rodman.
Virginia Polytechnic Institute	Blacksburg, Va.	S. R. Pritchard.
Virginia Military Institute	Lexington, Va.	Francis Mallory.
West Virginia University	Morgantown, W. Va.	W. E. Dickinson.
University of North Carolina	Chapel Hill, N. C.	Parker H. Daggett.
North Carolina College of Agriculture and Mechanic Arts	West Raleigh, N. C.	W. Hand Browne, Jr.
University of South Carolina	Columbia, S. C.	A. G. Carson.
Clemson Agricultural College	Clemson College, S. C.	W. M. Riggs.
University of Georgia	Athens, Ga.	U. H. Davenport.
Georgia School of Technology	Atlanta, Ga.	H. P. Wood.
University of Florida	Gainesville, Fla.	J. R. Benton.
University of Alabama	University, Ala.	Gustav Wittig.
Alabama Polytechinc Institute	Auburn, Ala.	A. St. C. Dunstan.
University of Mississippi	University, Miss.	John H. Dorroh.
Mississippi Agricultural and Mechanical College	Agricultural College, Miss.	Clarence E. Reid
Louisiana State University	Baton Rouge, La.	Thomas W Atkinson.
Tulane University of Louisiana	New Orleans, La.	Douglas S. Anderson.
University of Texas	Austin, Tex.	Arthur C. Scott.
Agricultural and Mechanical College of Texas	College Station, Tex.	F. C. Bolton.
Ohio State University	Columbus, O.	F. C. Caldwell.
Ohio University	Athens, O.	A. A. Atkinson.
Case School of Applied Science	Cleveland, O.	H. B. Dates.
University of Cincinnati	Cincinnati, O.	S. N. Taylor.
Purdue University	Lafayette, Ind.	C. Francis Harding.
Rose Polytechnic Institute	Terre Haute, Ind.	Frank C. Wagner.
University of Notre Dame	Notre Dame, Ind.	Jerome J. Green.
University of Illinois	Urbana, Ill.	Ernst J. Berg.
James Milliken University	Decatur, Ill.	E. C. Woodruff.
Armour Institute of Technology	Chicago, Ill.	E. H. Freeman.
Lewis Institute	Chicago, Ill.	P. B. Woodworth.
DePaul University	Chicago, Ill.	George J. Jenista.
Northwestern University	Evanston, Ill.	William C. Bauer.
State University of Kentucky	Lexington, Ky.	M. A. Wilson.
University of Tennessee	Knoxville, Tenn.	Charles A. Perkins.
University of Michigan	Ann Arbor, Mich.	George W. Patterson.
Michigan Agricultural College	East Lansing, Mich.	A. R. Sawyer.
University of Wisconsin	Madison, Wis.	M. C. Beebe.
University of Minnesota	Minneapolis, Minn.	George D. Shepardson.
State University of Iowa	Iowa City, Ia.	Arthur H. Ford.
Iowa State College	Ames, Ia.	Fred A. Fish.
Highland Park College	Des Moines, Ia.	F. H. Murphy.
University of Missouri	Columbia, Mo.	H. N. Shaw.
Washington University	St. Louis, Mo.	A. S. Langsdorf.
University of Arkansas	Fayetteville, Ark.	W. N. Gladson.
University of Oklahoma	Norman, Okla.	Harold V. Bozell.
Oklahoma Agricultural and Mechanical College	Stillwater, Okla.	A. P. Little.
University of Kansas	Lawrence, Kan.	George C. Shaad.
Kansas State Agricultural College	Manhattan, Kan.	Benjamin F. Eyer.
University of Nebraska	Lincoln, Neb.	G. H. Morse.
University of North Dakota	University, N. D.	Calvin H. Crouch.
University of South Dakota	Vermillion, S. D.	L. E. Akeley.
South Dakota State College	Brookings, S. D.	B. B. Brackett.
University of Montana	Missoula, Mont.	Arthur W. Richter.
Montana State College	Bozeman, Mont.	J. A. Thaler.
University of Idaho	Moscow, Idaho.	S. R. Sheldon.
University of Colorado	Boulder, Colo.	Herbert S. Evans.
State Agricultural College	Fort Collins, Colo.	F. A. DeLay.
Colorado College	Colorado Springs, Colo.	John Mills.
University of Utah	Salt Lake City, Utah.	Joseph F. Merrill.
University of Arizona	Tucson, Ariz.	E. M. Blake.
University of New Mexico	Albuquerque, N. M.	H. H. Conwell.
University of Washington	Seattle, Wash.	Carl E. Magnusson.
State College of Washington	Pullman, Wash.	H. V. Carpenter.
University of Oregon	Eugene, Ore.	R. H. Dearborn.
Oregon Agricultural College	Corvallis, Ore.	Thomas M. Gardner.
University of Nevada	Reno, Nev.	J. G. Langham.
University of California	Berkeley, Cal.	C. L. Cory.
Leland Stanford Junior University	Stanford Univ., Cal.	Harris J. Ryan.
California Polytechnic College	San Luis Obispo, Cal.	H. B. Waters.
Throop Polytechnic Institute	Pasadena, Cal.	R. W. Sorenson.
University of Southern California	Los Angeles, Cal.	Arthur W. Nye.

1 Absent on leave.

CENTRAL-STATION PRACTICE

Transmission—Interior Wiring.

ELEMENTS OF POWER-STATION DESIGN.—XII.

INSTALLATION DETAILS.—I.

BY W. B. GUMP.

The development of details naturally follows the final wiring scheme and the general arrangement of the plant to be adopted. The importance of details relating to the construction of the plant cannot be overestimated. In fact, the character of the plant when completed is determined by the design of details. This is particularly true with the electrical portion. The present description is to deal with the question of installation, referring chiefly to the electrical side.

Foundations for Prime Movers.—The design of foundations for the prime movers is among the first in the list of items to be settled. The character of foundation required involves the specific properties of the type of prime mover chosen. If a reciprocating-engine plant, the matter of vibration is a serious one, and hence requires provision for more than weight alone. With a steam turbine, the problem of vibration is practically inconsiderable.

In the case of waterwheels of the Francis type the items demanding attention are: (*a*) Dead weight of waterwheel; (*b*) dead weight of water in wheel when operating at full load; (*c*) thrust of water under varying load conditions. The last item will vary according to the head and the type used, but is generally a considerable quantity. A high safety factor is used in any case, and this will invariably accommodate all conditions which are normal. With respect to waterwheels the question of thrust is often a complex one, and affects the entire pipe line. This is a matter to be dealt with by a specialist whose opinion of the construction is often of more value than that of an electrical engineer.

The design of foundations for large gas engines introduces factors similar to those applying to reciprocating units. Here the vibration is more aggravated than with a steam engine of the same capacity. It may be said that foundations should be monolithic in construction, so that settling of one portion away from another is prevented.

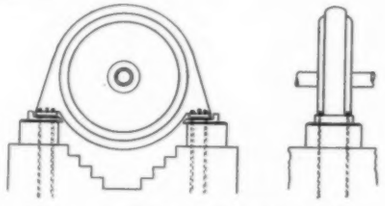


FIG. 1.—ENGINE-TYPE GENERATOR.

Generator Foundations.—The foundations for generators should be arranged with openings below, which allow accessibility to the terminals and under portion of the frame. It is usual to design the foundation with the entire middle portion left open down to

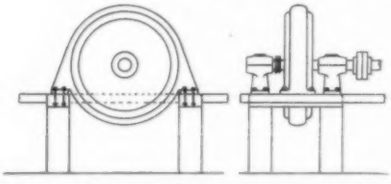


FIG. 2.—WATERWHEEL-DRIVEN GENERATOR.

the basement floor, or a trifle above. It is practicable also to construct an extra heavy floor, allowing this to carry the entire weight, with the assistance of columns below. With this arrangement the entire space beneath the generator is available for inspection, cleaning and repairs, and offers ample space to support cables and other accessories. This type of foundation applies more particularly to waterwheel units than to the engine type.

The type of solid foundation formerly used, and still found in many stations, is not to be recommended. Its disadvantages are: (*a*) Water may easily collect in the opening beneath the frame, due to a leaky steam or water pipe; (*b*) terminals and lower windings are inaccessible.

Fig. 1 shows the usual construction for an engine-type generator, and Fig. 2 the waterwheel-driven generator, illustrating the open type of construction. The main leads may be carried from the generator in tile or fiber conduit in the main floor, or may be supported beneath. Local circumstances will determine which method is best for a particular case.

Switches and Bus Structures.—This feature of the plant usually requires more thought than any other part of the wiring system, and must be worked out with due respect to accessibility, as well as economy in space occupied. When laying out a busbar system it will be found that the number of ways in which the structure may be built is almost endless. After a systematic study of many schemes it is not difficult to settle upon the one which best suits the conditions in question. The discussion taken up here applies only in a general way, since no two plants face the same identical conditions.

The first question which appears is the amount of space available for the initial installation. The second is provision for accommodating future extensions. The latter item is generally more serious in a large substation or in a steam power station than in the typical hydroelectric plant, since a hydroelectric plant provides at the outset for a definite maximum development, and is designed accordingly. With plants having a mixed load the design of suitable switch and bus structures is more complex and requires keen judgment, in order to bring about harmony with the rest of the plant.

Starting with the assumption that the generator potential is 12,000 volts, and assuming further that the entire plant is three-phase, we may complete

a cross section of the station outlined in the previous chapter. Such a section will take the form of Fig. 3. In the plant shown it is to be noted that the main runs are parallel, and are divided in a symmetrical manner between the four units. Such symmetry is rather unusual, since the spacing of the units must conform to the space required by the prime movers, and in most plants the switching apparatus cannot be made to suit the available space per unit which would result in perfect symmetry. The advantage of straight runs is apparent, and these should be sought as far as possible, since such an arrangement greatly simplifies the construction.

Current and Potential Transformers.—Current transformers must be provided at some point in the generator leads, between the terminals and the generator switches. It is advisable in any case to provide fireproof barriers for separating both current and potential transformers. Other forms of construction can hardly be considered first class.

Potential transformers should be located with ample space for removing without interference with neighboring apparatus or live conductors. Fig. 3 shows in a general way the relative space occupied by various pieces of apparatus. It must be remembered that the illustration given is a preliminary drawing, and hence subject to change in many of the details. Ample opportunity is afforded for running control and instrument wires to the operating gallery at the distant end. These may be grouped in almost any desired way. For example the wiring from potential transformers can be carried in conduit below, making practically a direct run to the instrument board. The same method applies to wiring from the current transformers.

Transformers Inclosed in Compartments vs. Exposed.—The methods of installing high-tension transformers seem to vary widely as far as details are concerned. There are but three general arrangements: (*a*) Individual transformers set in separate fireproof inclosures; (*b*) transformers grouped, and each group inclosed; (*c*) transformers on main floor, (or with other apparatus) entirely exposed.

As to the best of these methods there has been some difference of opinion. Quite a number of stations may be cited where disastrous fires have occurred because there were no walls, pits, or compartments, serving to confine the trouble to one locality, but allowed it to spread to all portions of the plant. While such a fire may never occur, it is advisable to provide for the unexpected notwithstanding, for the reason that the risk of having such a calamity may result in a financial loss many times greater than the extra cost of providing a means of segregation. On the other side of the question is the fact that an oil-insulated transformer, properly constructed is unlikely to give serious trouble, due (1) to the fact that bursting of the case can only occur under extreme internal pressure, and such pressure is the result of many turns burning out simultaneously, and (2) such pressure may be taken care of by means of a suitably constructed emergency valve or outlet, such as an inverted U bend connected to the top of the case, and extending to a sewer or other drain, below, thus offering a vent for high pressure.

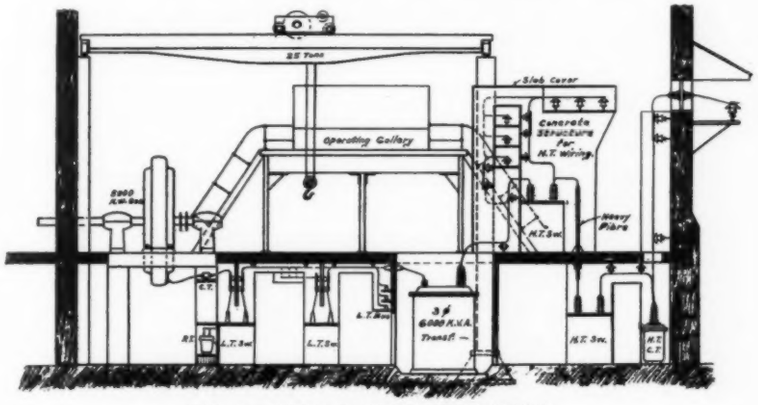


FIG. 3.—CROSS SECTION OF STATION.

A transformer is a self-contained device, and may be designed to withstand an enormous unit pressure. From this fact it is evident that the fire hazard within the transformer itself may be reduced to a very small quantity. The construction of barrier walls is expensive, and requires quite a large amount of additional space in order to have complete access to each transformer. In very large stations, however, the proportionate cost of transformer compartments is generally small, and in such cases the feasibility of segregating transformers is hardly questionable, especially with very high potential.

With air-blast transformers the danger of fire is greater in proportion, and although this is true, it will be found that air-blast transformers are generally placed as close together as the oil-cooled type, and it is rare to find them protected by any form of wall or fireproofing.

One distinct advantage of compartments is found in a means of supporting conductors without special framework. The method of carrying conductors from the three-phase transformer above shown, is necessarily much simpler than with a group of single-phase transformers. The wiring for the latter could be supported more easily by means of walls than without them, even though the wiring is less simple than with the three-phase transformer.

The greatest danger is in the vicinity of the terminals, and it should be stated here that every precaution is necessary to protect the wiring above the transformer. It is generally impractical to extend barriers down to the terminals, and for that reason there should be extra heavy insulation at all portions which are liable to come in contact with other apparatus, either from a burn-out, due to outside trouble, or from interference within the plant.

On account of lightning, many unforeseen accidents are possible, and provision should be made against them. Burn-outs and arcs may arise from switching as well as from lightning disturbances. In either case the strain between terminals is likely to reach an enormous value. An arc once formed produces serious damage if not confined to one particular location. Here an "ounce of prevention" is worth even more than "a pound of cure," and with first-class insulation and fireproofing

the opportunity for arcs becomes very remote.

By placing the transformers on the main floor instead of in pits below, as shown in Fig. 3, several advantages might be gained. One is that the high-tension switches could all be located in the basement, and in this way decrease the width of the building. A second advantage is that piping to the transformers can be more conveniently arranged for draining and supplying oil and circulating water.

One of the greatest disadvantages in having the transformers on the main floor is that the wiring and piping are apt to interfere with each other. With the first arrangement the connections to the transformer are more direct, while at the same time the piping is easily separated from both high-tension and low-tension leads, and crossing entirely avoided. A good method of construction for high-tension wiring between single-phase transformers is to arrange the wiring similar to that of a bus structure. Assuming that the transformers are placed on the main floor the arrangement suggested is shown in detail in Fig. 4. In the case assumed the piping for circulating water is carried below the floor. The reverse arrangement is also feasible, in which the wiring connections are brought below, and the piping above the floor.

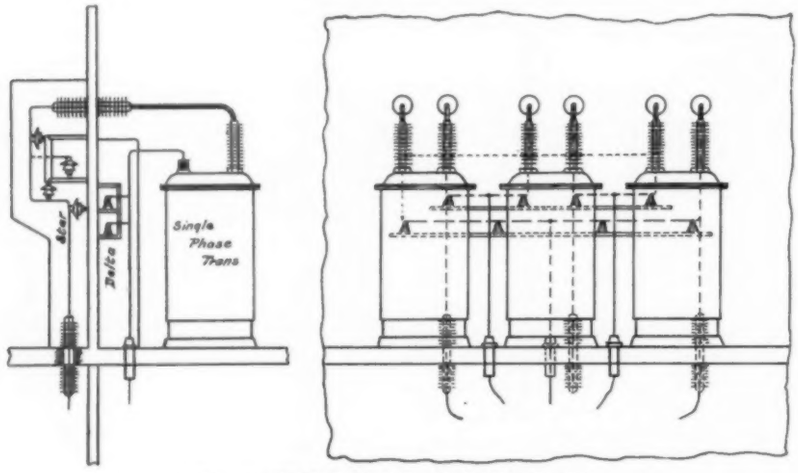


FIG. 4.—TRANSFORMER ARRRANGEMENT.

(To be Continued.)

EDITOR'S NOTE.—This important series of articles started in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, September 3, 1910, and will cover every phase of central-station design. The treatment is elementary and withal practical throughout, and the complete series will constitute a standard and reliable treatise on this important subject.

Disturbing Noises of Electric Machines.

Direct-current machines frequently produce a disagreeable sound when the carbon brushes are too hard, or when the contact between them and the commutator is faulty; it may also be caused by a rough surface of the commutator or a slight projection of the mica between the copper segments. To remove such noises is a very simple matter. More disagreeable is the humming sometimes caused by the blades on the commutator or winding heads, which act as ventilators when the machine is running. To stop this noise is out of question, as it would be detrimental to the cooling of the machine; and, at any rate, this humming is rarely so intense as to be a real disturbance. Besides these mechanical causes one has to deal chiefly with magnetic effects. It is particularly the form and number of the slots that may give rise to disagreeable singing, and at times even to a howling sound. The chief reason for this is probably that the lines of force traveling from the pole-shoe to the armature are not immovable in the space between poles and armature teeth, but are pulled to and fro. This change of direction of the lines of force produces quick vibrations of the parts in question. Thus there takes place a continuous fluttering of the lines of force not only in the air gap, but also in the pole-shoe and armature teeth, which may obviously be increased or diminished by the form and number of the teeth. If only a few wide slots lay under the pole-shoe, the fluttering of the lines of force will be considerably stronger and penetrate more deeply into the pole-shoe than when there are many narrow slots under the pole-shoe. In general, therefore, a definite number of slots per pole may be indicated which cannot be exceeded without danger of producing the magnetic singing. This number, however, is not absolute, but depends on the width and depth of the teeth. Two-pole machines sing more rarely than those with four poles, because in the former, with an equal number of slots, there are twice as many slots per pole as in the latter. The air gap also has a great influence on the formation of the sound. Machines with a small air gap, even if the number and form of the slots are within permissible limits, will surely sing. The form of the pole-shoe is likewise an important factor in the production of noise. The latter will be intensified when the pole-shoe is situated throughout at the same distance from the armature iron, that is, when the air gap is constant, and it will be diminished when the pole-shoe has a less curvature, and the air gap increases gradually from the center toward both sides. Unfortunately this form unavoidably involves a certain waste of copper. It should also be observed that the length of arc of the pole influences the noise. A machine with a pole subtending a smaller angle will have a greater tendency to sing than one with a larger angle. A further cause for the production of noise may consist in an excessive loading of the machine, chiefly of the armature teeth. However, besides the constructive faults named there occur defects of manufacture, which may give rise to unpleasant noises, as too loose packing and pressing of the sheets comprising armature and poles, insufficient riveting of the same, bending of the armature teeth during milling and careless handling of the unwound armature. The punching of armature sheets is therefore preferable to milling. The noises occasionally observed in transformers may usually be traced to an improper manufacture of the yokes and can be easily removed by pressing the joints more tightly together.—(Translated and abstracted from the *Elektrotechnischer Anzeiger*, September 29.)

Electric Hoist in Mexican Mine.

A new electric hoist has been installed at the old Sierra de Cobre shaft, Cananea, Sonora, Mexico.

TELEPHONY—TELEGRAPHY, and WIRELESS.

TELEPHONE REPEATERS.[1]

BY BÉLA GÁTI.[2]

A large number of experiments have been made on the subject of telephone receivers which serve to repeat the message with intensified current. The number of patents is already very large and yet there is no apparatus which answers in all respects to the practical exigencies. I have been occupied with this question for a number of years and have found that the failure is due to two circumstances. One of these is that the fundamental tone of the repeater is too low, while the other may be attributed to the lack of sensibility of the repeater. In the course of my experiments I have become convinced that the fundamental tone of the receiver as well as that of the membrane of the microphone is lower than it should be. If we connect the two systems, the fundamental tone is lowered still more from increasing the mass, and thus the repeater not only fails to intensify the low tone, but even less will it increase all of the high tones which are absolutely necessary for the intelligibility of the message; on the contrary it will decrease these. As a result, the repeated discourse becomes mutilated and incomprehensible.

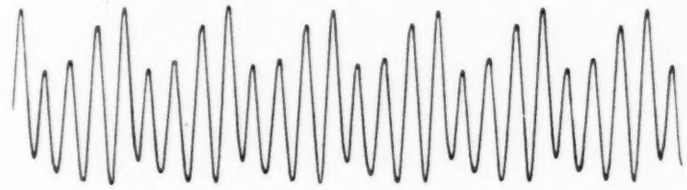


FIG. 1.

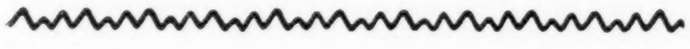


FIG. 2.

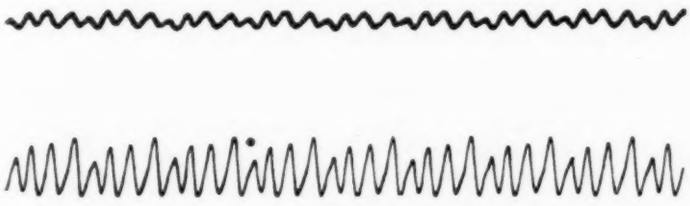


FIG. 3.

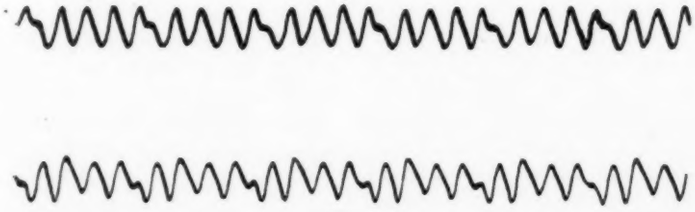


FIG. 4.

The second cause, which has been prejudicial to the utilization of the apparatus, is that the repeater has been habitually employed for the strengthening of very weak currents. In the apparatus employed today, supposing a conductor of four millimeters diameter, in a length of 1,000 kilometers, the stray disturbing currents which are found in the circuit tend to counteract the telephonic currents and may exceed the latter in intensity. But the disturbing currents are always of low frequency. In consequence it may very easily occur that the repeater brings out more strongly the disturbing current than the telephonic current as a result of which intelligibility becomes impossible. The repeater should consequently be applied where the intensity of the telephonic current is still in excess of that of the disturbing current. For the apparatus employed today this would mean a distance of a few hundred kilometers, and I do not think that it will be possible to construct a repeater suitable to the microphone used today. On the contrary it is otherwise with respect to the microphone for heavy currents, by means of which conversation without a repeater is possible at several thousand kilometers. In applying in this case a repeater at the end of the first thousand kilometers we shall be able to attain a high degree of action, as is demonstrated by the accompanying oscillograms. The mean values of the current strengths are given with these curves. It may be seen

1Paper presented at the International Conference of European Telephone and Telegraph Administrations, Paris, September, 1910.

2 Chief Engineer of Telegrapns, Budapest.

from these curves that by the employment of a repeater the intensity of the arriving current may be increased about ten fold. We shall be able then by the employment of a repeater to transmit over thousands of kilometers.

Figs. 1, 2, 3 and 4 are oscillograms obtained while sounding the vowel *a* in front of the transmitter. The line wire in each case was four millimeters in diameter, the length of line being 1,300 kilometers for Fig. 1 and 2,100 kilometers for Figs. 2, 3 and 4. The repeater is inserted 900 kilometers from the transmitter. Fig. 1 represents the current received at the end of the line with the repeater (upper curve) and when it is omitted (lower curve). The values of the two currents are 1,928 and 212 micro-amperes. Fig. 2 shows corresponding curves for the longer line, the current values being 318 and 50 micro-amperes.

In Fig. 3 the upper curve represents the current of 318 micro-amperes at the end of the line and the lower curve shows the current of 1,060 micro-amperes entering the repeater. In Fig. 4 are shown the currents leaving (upper curve) and entering (lower curve) the repeater.

With the repeater I have employed a microphone constructed for cooling similar to those which serve to telephone over long distances. With the repeater we are, of course, not restricted to any place, and we are able in consequence to employ the cooling in a much higher degree. Similarly in the case of the repeater we are not limited to the use of the ordinary receiver, in consequence of which we shall be able to employ receivers of large size, that is to say, of small ohmic resistance. In this case the strength of the transmitted current is larger and we shall be able to extend the former limit for repeating. Between the current arriving at the repeater and that leaving it there is a considerable difference of time, which, however, does not interfere with the transmission any more than the fact that the arriving currents need time for traversing the circuit, interferes with it.

In Fig. 5 I have shown the relation which existed at the beginning of the experiments between the current at the receiver and the strength of the repeated current. The intensities of the current have been measured by the oscillograph in arbitrary units. The curves are plotted to the same scale and as may be seen they are very different. Further, it is seen from this figure that there is a definite number of oscillations of the voice giving resonance and I have shown the same result with respect to the membrane of the transmitter. To my mind the experiments should be extended by using not one but several repeaters of which one should be adjusted to the mean frequency of the human voice, one to the vowel *a* (900 cycles), and one other to a much higher frequency. However, whether the repeaters be inserted in the circuit in parallel or in series the reciprocal action produces very confusing conditions, and that is why this question has not already found a solution. I am, however, of the opinion that it is only a question of time when the experiments will show results, after which the repeater will be successfully applied in practice.

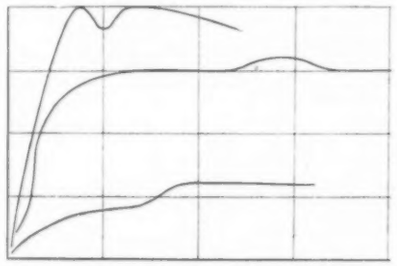


FIG. 5.—RELATION BETWEEN CURRENTS AND FREQUENCY.

Underground Conduit for Long-distance Telephone Lines.

The laying of an underground conduit for the long-distance telephone cables of the American Telephone and Telegraph Company between Wilmington, Del., and Washington, D. C., a distance of ninety-two miles, has been nearly completed. The work on this conduit has been under way nearly two months.

This conduit comprises the southerly portion of a continuous line of underground construction, which will eventually connect the city of Boston with the capital of the nation. Conduit has already been laid from Boston to Providence, from New Haven to New York, and from New York to Wilmington. The completion of the present section will therefore connect New York and Washington with underground lines and eliminate disturbances from storms, such as the memorable one of March 4, 1909.

In a recent number of *The Telephone News* the construction work on the stretch from Wilmington to Washington is described. This conduit consists of four ducts of creosoted wood throughout the major part of the run, being increased to five and six ducts where it passes through the towns. For the greater portion of the distance, through the open country, no plank protection is used on either the top or bottom of the conduit, as there is small danger of injury from digging, etc.

One of the novel features of the construction lies in the use of a new type of manhole, built up of concrete slabs and blocks. The manhole, is barrel-shaped, three feet wide by four feet six inches long, with three feet headroom. For each side wall two concrete slabs are employed, three inches in thickness, reinforced with expanded metal. For the roof, two reinforced slabs, each four inches in thickness, are used. In place of the usual iron manhole casting, a concrete cover twenty-four inches in diameter is used, both roof and cover being sunk twelve inches beneath the surface of the roadway. In all, there are sixteen concrete blocks or slabs employed in the construction of the manhole.

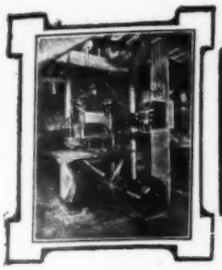
Lower Cable Rates to Be Made.

A cut in cable rates is being arranged by the Commercial Cable Company and the Postal Telegraph Company, which will effect considerable saving in the sending of ordinary cablegrams. Clarence H. Mackay, president of both companies, gave out a statement that if suitable arrangements can be made with the European governments interested, the charge on cable messages not in code will be reduced from twenty-five cents for a word not exceeding fifteen letters to twelve and one-half cents for every five letters sent.

Commonwealth Edison's Telephone.

The private telephone exchange of the Commonwealth Edison Company, 139 Adams Street, Chicago, is now handling an average of 13,000 calls of all kinds per day, with a *peak load* of 1,700 calls an hour as a maximum.

It is reported that William Marconi recently directed an exchange of wireless communications between the wireless station at Coltano, Italy, and the station at Glace Bay, Nova Scotia.



Industrial Power

ELECTRIC POWER IN THE IRON AND STEEL INDUSTRY.[1]—I.

BY J. J. ELINK SCHUURMAN.

Utilization of Waste Gases.—For some time serious attention has been given to the most economical manner of utilizing blast-furnace gases for all processes in the manufacture of steel which require mechanical energy. Economical utilization necessitates centralization of the power, for which electricity furnishes the most efficient and convenient means.

At the present time steam turbines or gas engines are used for driving the electrical generators. Gas engines are more economical from a thermodynamic standpoint, especially as the efficiency of steam boilers, using blast-furnace gases for fuel, is very low. For the production of one kilowatt-hour by a gas engine, about 4,500 calories (17,850 British thermal units), equal to about 180 cubic feet of gas, are needed, whereas in the case of steam turbines about 9,000 calories (35,700 British thermal units), or about 360 cubic feet of gas, are necessary for the production of the same amount of energy. Against the better heat economy of the gas engines must be put the lower first cost of steam-turbine installations, amounting to approximately twenty-five per cent. The latter allow, moreover, of installing considerably larger units, the entire operation of the plant becoming much simpler and capable of being easily superintended. Also the room occupied by steam-turbine sets, attendance necessary, and oil consumption are reduced. Further, steam turbines stand the shocks occasioned by sudden changes of the load much better than gas engines, which can be overloaded only to a small extent, and their parallel working is more efficient. It consequently depends on circumstances which drive is to be preferred, and a combined drive is often suitable. In Germany, for instance, several steelworks have gas-power stations in which are installed one or more steam turbines. The latter, by taking up the overloads, lessen the danger of the gas engines falling out of step.

By the centralization of the power production in an electrical central station it is possible to deliver superfluous quantities of gas, for which there is no use in the plant itself, to outside consumers, in the form of electrical energy. This may prove a means of increasing the income of the steelworks. There already exist several steelworks which supply neighboring towns with light and power from this source.

It is also possible to connect the power station of the steelworks with some long-distance distributing station. Ordinarily the latter will supply energy from the steel plant. In cases of emergency, however, as, for instance, through interruption of the working of the blast furnaces, the long-distance distributing station will supply the missing energy.

In steelworks where there are no blast furnaces in the immediate vicinity, steam turbines have nearly entirely been adopted for the generation of energy.

System of Supply.—With regard to the choice of system of current supply, most of the older steelworks installed continuous current. Only the smaller equipments were driven electrically, and the distance over which the current had to be supplied was not great. For this purpose continuous current was very suitable, especially as continuous-current motors have the advantage of being easy to regulate.

With the extension of electrical installations the distance over which electrical power was used increased. Also the electrical drive came into use for the larger consumers, for instance, in rolling mills, so that the distribution with continuous current became more and more uneconomical.

At the present time, owing to the extensive installations of modern steelworks, alternating current is usually adopted, it being possible with alternating current to conduct large quantities of energy over long distances with comparatively small loss. Its only disadvantage, until recently, lay in the fact of the impossibility of regulating the speed of alternating-current motors in an economical manner. This disadvantage has since been overcome in several ways, which will be described later.

Speed Regulation of the Motors.—In regulation of speed a distinction must be made between speed reversal, and speed regulation in one direction of rotation. The reversal problem, as applied in the case of reversing rolling-mills, has already been so often discussed that it need not be dealt with here. In speed regulation in a definite direction of rotation a distinction must be made between the adjustment of different no-load speeds with a slight drop of speed between no load and full load, the adjustment of different no-load speeds which drop to a certain adjustable extent between no load and full load, and a regulation which causes a large drop of speed when the load is applied, but does not permit of adjusting at various no-load speeds.

Furthermore, it is often required that the output should remain constant at all speeds. However, a constant torque over the entire range of speed regulation is generally sufficient.

For the driving of rolling mills it is often necessary to obtain different no-load speeds, depending upon the rolling schedule. The sort of mill used will determine whether these speeds should remain constant from no load to full load, or whether a drop of speed is required. The latter will be the case for blooming or similar mills, with which considerable peak loads are experienced, which must be taken up by

1 Abstract of a paper presented at the Buxton (England) meeting of the Iron and Steel Institute, September 26-30, 1910.

the use of rotating masses. For wire mills and the like, where the load remains fairly constant, a drop of speed is not necessary.

A constant output for all speeds is often required for mill operation; that is to say, an increase of torque at decreasing speed, which may lead to an increased production.

The drive of blast-furnace blowers, and still more, of steelworks blowers, presents an interesting phase of the speed-regulation problem. Up to the present time reciprocating blowers, driven by reciprocating steam engines, or often by gas engines, have generally been used. Recently, however, high-speed rotary blowers, which have certain advantages when compared with reciprocating blowers, have more and more been adopted. In comparing the respective usefulness of the two types of blowers, reliability of operation first comes into consideration. In this respect, absence of all mechanism liable to wear, less attendance required, continuous and steady delivery of air, give the rotary blower a considerable superiority over the reciprocating. Further, it occupies much less room, and its first cost is smaller.

When the speed is constant the high-speed rotary blower produces a pressure which is practically independent of the volume of air delivered, the volume depending only upon the section of the tuyeres. A change of pressure can be obtained by varying the speed, and as the pressure increases approximately with the square of the velocity, comparatively small alterations in the speed will suffice to produce the pressure variations necessary for the operation. Thus the pressure curves of high-speed rotary blowers can be brought to higher or lower levels by an increase or decrease of the speed, while the efficiency curves remain practically the same. (See Fig. 1.)

Rotary blowers require high speeds, consequently for driving them the steam turbine receives first consideration, especially as it meets the requirements of regulation to a great extent. The exhaust-steam turbine is particularly favorable for this purpose, as it is capable in a much higher degree than the reciprocating steam engine of making use of the energy of the steam down to the lowest possible vacuum. When it is considered that the exhaust steam of rolling engines, which in many cases escapes to the atmosphere, can be utilized in exhaust turbines, and the heat it contains converted into mechanical energy as far as technically possible, the economy of such a drive will become self-evident.

In the case where a large gas-engine power station exists, it may prove to be more suitable, on account of the better centralization obtained, to drive the blowers electrically. Also for reserve blowers, which are necessary where the main blowers are driven by gas engines, the electrical drive will be of advantage, on account of its low cost.

As driving motor only a high-speed motor can come into question, which, except in special cases, should meet the requirements of an easy and economical speed regulation. The needs of the blast-furnace blowers are comparatively easy to meet. Steelworks blowers, however, require to supply pressures from five to thirty-five pounds per square inch, as well as a widely varying volume of air. The driving motor should consequently in this case permit of a wide range of speed regulation, and preference must be given to that form of speed regulation for which the once-adjusted speed does not vary between no load and full load.

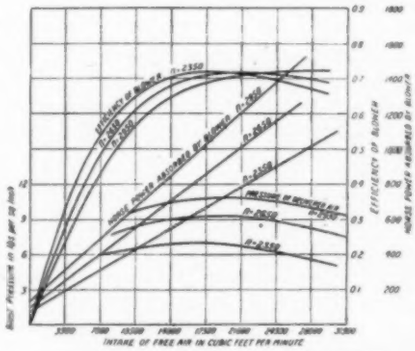


FIG. 1.—CHARACTERISTIC CURVES OF HIGH-SPEED ROTARY BLOWER.

Besides the principal operations above mentioned, *viz.*, rolling mills and blowers, various small drives requiring regulation of speed come into account. Mention should be made of live roller beds, cranes, transporting apparatus of all sorts, hoists, hydraulic pressure pumps, etc. Most of these drives must also be reversible.

Resistance Regulation for Induction Motors.—As already mentioned, the continuous-current motor adapts itself in a favorable manner to the different forms of speed regulation. The most varied characteristics may be obtained with the shunt, compound and series motor. However, the use of continuous current is limited in large plants for the reasons given before, so that alternating current has now generally been adopted.

The best known and most extensively used alternating-current motor is the three-phase induction motor. It has the great advantages of simplicity and safety of operation, but in its original form the speed, which depends upon the number of poles and the supply frequency, cannot be economically regulated. The simplest means of varying the speed is to insert an adjustable resistance—known as a slip resistance—into the rotor circuit. This method has often been used for regulating the speed of rolling mills, but is very uneconomical, because an amount of energy, which is proportional to the percentage of the regulation, is lost in the slip resistance. When, for instance, the speed is decreased to thirty per cent below normal, thirty per cent of the energy taken from the line is lost. In consequence the efficiency is very low.

Another disadvantage of this system of regulation is, that for a once-adjusted slip resistance the speed changes to a very great extent with variations of the load, and rises to practically its normal value at no load. This running back to the synchronous speed can be of great inconvenience in the operation of rolling mills, as it is just when running light that a low speed is required in order that the rolls may be sure of getting a hold on the steel.

Power-Factor.—The power-factor is another characteristic of the induction motor to which close attention should be given. It is the power-factor which determines the proportion of the total current generated which is available for power purposes; a low power-factor means larger and more expensive generating plant, increased losses throughout the system, and often inferior pressure regulation.

Exact measurements have shown that industrial plants which are driven by induction motors have usually a power-factor between 60 and 85 per cent, although the upper limit is but seldom reached. Rolling mills are examples of installations with a low

power-factor. The reasons for this are that low-speed motors (which naturally have a low power-factor) are commonly employed, that the load has an intermittent character, and that rolling-mill motors have large air gaps for mechanical reasons, so that their magnetizing current is large.

From the foregoing it results that the induction motor in its original form possesses disadvantages for the driving of iron and steelworks machinery. From a suitable motor should be expected an easy and efficient speed regulation, and, if possible, compensation of the phase difference, resulting in a favorable power-factor. Recently certain systems of economical speed regulation for induction motors, which fully meet these requirements, have come into use.

(To be continued.)

Benefits of Motor Drive.

The illustration reproduced herewith is taken from the October, 1910, issue of *The West Ham Electrical Bulletin*, the quarterly publication of the West Ham (London, England) Corporation Electricity Department. The caption under the original cut is as follows: "Note the thirty-horsepower electric motor fixed on the girder staging at the extreme right of the picture. Immediately underneath the motor is to be seen the disused forty-horsepower steam engine which now only awaits a suitable purchaser."

A glance at the picture shows the disparity in size between the cumbersome old engine with its bulky foundation, and the neat little motor. When the old plant is removed it is easy to see the improvement in the appearance of the shop that will result, not to mention the extra floor space that will be available for machine tools. The steam piping will also vanish, and with the boiler room, coal-storage bins, ash heap, and other impedimenta that are inseparable from the steam-engine-driven establishment. It is to be supposed that the question of retaining the machine tools, or the cost of converting these for the purpose, precluded the use of the individual-motor drive, when so many advantages would have accrued from the abolition of the lineshaft, countershafts, and belting; but even without this added refinement the improvement in the shop is noteworthy, or will be when the engine is taken out.

The view given is that of the machine shops of S. H. Johnson & Company, Ltd., West Ham.

SHOWS OLD ENGINE AND MOTOR THAT REPLACES IT.

Coke-Oven Power in Belgium.

The electric generating plant at the works of the Cockerill Company, at Seraing, near Liége, Belgium, which already supplies current for 1,104 arc lamps, 6,028 incandescent lamps, and 717 motors, is being increased by the addition of a new gas engine and dynamo, the fuel being the hitherto wasted gas from the coke ovens.

The United Collieries Company, Ltd., is considering the linking up of seven of its coal mines in Lanarkshire, Scotland, in order to provide for a centralized electrical distribution of power.

Electric Furnaces in California.

According to *Mining Science*, the Noble Electric Steel Company is completing plans and specifications for five new furnaces, and will commence construction at an early date. The recent rains have so augmented the water reserves of the Northern California Power Company that it is busily enlarging its power facilities and will commence the delivery of an immense voltage to the smelter at Héroult shortly. With the increased electrical power available the Company will blow in its smelter, which has been idle since July.

Coke-Oven Plant in England.

A report from Spennymoor, England, states that at one of the coal mines of Bolckow, Vaughan & Company, the waste heat from the newly added coke ovens is used for firing a battery of twelve Lancashire boilers. The new plant is all electrically driven and a Curtis mixed-pressure turbine of 750 kilowatts capacity has been added in the power house. Exhaust steam from three winding engines and various auxiliaries is largely used for power generation, the final exhaust being handled by a barometric condenser.

Freshening an Artificial Pond.

An artificial pond in Richmond Park, Glasgow, is supplied with water from the River Clyde by an electric pump. The same pump is used in refilling the pond when the latter has been emptied after one of its periodical flushings to prevent stagnation.

An Electrically Driven Cement Works.

The Dakota Portland Cement Company, Chamberlain, S. D., has let the contracts for the new plant now being built in that town. Turbines will be used in the power plant, and there will be no less than thirty-three electric motors for driving the heavy machinery.

Electric Drive for Leather Factory.

Spence Brothers, Saginaw, Mich., have let the contract for the construction of a leather factory which will be driven throughout by electricity.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

EDISON ELECTRIC ILLUMINATING.

The report of the Edison Electric Illuminating Company, of Boston, for the month of October and four months ended October 31, compares as follows:

	1910	1909
October gross	$ 427,636	$ 397,586
Expenses	183,855	187,403
October net	243,781	210,183
Four months' gross	1,458,619	1,276,321
Expenses	679,687	645,252
Four months' net	778,932	631,069

AURORA, ELGIN & CHICAGO.

The report of the Aurora, Elgin & Chicago Railroad Company for the month of September and three months ended September 30, 1910, compares as follows:

	1910	1909
September gross	$ 161,599	$ 149,141
Expenses	83,177	74,467
September net	78,421	74,673
Charges and taxes	33,053	29,413
September surplus	45,368	45,260
Three months' gross	522,716	480,453
Expenses	258,266	228,810
Three months' net	264,451	251,643
Charges and taxes	98,661	87,663
Three months' surplus	165,789	163,979

NIAGARA FALLS POWER.

The combined income account of Niagara Falls Power Company and Canadian Niagara Power Company, as reported to the New York Stock Exchange for the nine months ended Septemper 30 follows:

Total operating revenue	$1,607,537
Operating expenses and taxes	452,191
Net operating revenue	1,155,346
Other income	102,998
Total income	1,258,343
Fixed charges, etc	798,438
Surplus	459,904
Previous surplus	538,027
Total surplus	997,931
Dividends	167,900
Adjustments, etc., debt	68,461
Profit and loss surplus Sept. 30, 1910	761,570

UNITED RAILWAYS OF ST. LOUIS.

The report of the United Railways of St. Louis, for the month of September and nine months ended September 30, compares as follows:

	1910	1909
September gross	$ 965,943	$ 924,993
Expenses, taxes and depreciation	642,182	589,357
September net	323,761	335,636
Other income	6,020	4,335
Total income	329,781	339,971
Charges	233,233	232,132
September surplus	96,548	107,839
Preferred dividends	70,777	70,763
Surplus	25,771	37,076
Nine months' gross	8,559,204	8,195,315
Expenses, taxes and depreciation	5,768,826	5,217,704
Nine months' net	2,790,377	2,977,610
Other income	30,646	31,071
Total income	2,821,024	3,008,681
Charges	2,100,709	2,101,632
Nine month' surplus	720,315	907,049
Preferred dividends	636,911	636,870
Surplus	83,403	270,179

AMERICAN TELEPHONE EARNINGS.

The statement of results of the American Telephone and Telegraph Company for the year ended June 30, filed with the Massachusetts Highway Commission, shows a balance earned available for dividends of $26,285,440, equivalent to 10.11 per cent on the $259,846,200 of stock outstanding June 30, compared with $19,419,413 in the previous year, or 8.16 per cent on the $237,788,100 of stock outstanding June 30, 1909. The figures for three years compare as follows:

	1910	1909
*Gross	$16,503,890	$15,025,518
Expenses	8,446,159	7,496,508
Net	$ 8,057,159	$ 7,529,010
Other income	24,017,390	19,684,657
Total net	$32,074,549	$27,213,667
Charges	5,789,109	7,794,254
Balance	$26,285,440	$19,419,413
Dividends	19,757,337	13,970,355
Surplus	$ 6,528,103	$ 5,449,057

*Telephone lines directly operated, licensee companies, etc.

In the statement of condition as of June 30 the principal changes in assets as compared with the previous statement appear in the item "securities of other companies," $316,409,145, an increase of $72,173,685, and in "current assets" $102,187,511, a decrease of $34,985,399. Total assets, $475,637,374, compare with $455,999,542 in the previous statement. On the liabilities side capital stock shows an increase of $22,058,100, to $259,846,200; bonded debt a decrease of $29,560,000, to $96,616,000, sinking and other special funds $12,971,208, to $34,181,498; and surplus, $13,654,021 to $50,781,697.

The sources of "gross" revenue, with comparisons, were as follows:

	1910.	1909.	1908.
Exchange service	$10,062	$9,383	.....
Toll service	10,033,132	9,338,474	8,947,006
Licensee companies	6,265,312	5,543,221	5,424,786
Conduit, polls and roof rent	195,383	134,439	169,602

Other income was derived as follows:

Real estate	$96,734	$154,267	$205,548
Dividends from other companies	18,027,624	13,861,639	12,365,301
Interest on bonds other companies	5,124,271	4,974,675	5,718,397
Miscellaneous	768,760	694,075	93,202

THIRD AVENUE RAILROAD (NEW YORK.)

The New York Public Service Commission has issued a report of the receiver of the Third Avenue Railroad Company for the quarter and twelve months ended June 30, 1910.

	1910.	1909.
Gross	$906,342	$770,321
Expenses and taxes	610,298	447,763
Net	296,044	322,558
Other income	8,396	11,333
Total income	304,440	333,891
Charges	108,651	118,446
Surplus	195,788	215,445
July 1 to June 30:		
Gross	3,369,922	2,969,640
Expenses and taxes	2,004,977	.....
Net	1,364,945	.....
Other income	15,921	.....
Total income	1,380,866	1,111,452
*Charges	406,704	422,503
Surplus	974,162	688,948

*Does not include interest on $37,560,000 first consolidated mortgage bonds and $5,474,769 notes.

Allis-Chalmers Company.

In the annual report of the Allis-Chalmers Company for the year ended June 30, 1910, the profit and loss account compares as follows:

	1910	1909	1908
*Profit and operation	$2,576,818	$1,809,009	$2,573,961
Maintenance, depreciation, etc.	2,081,086	1,673,578	1,958,147
Net profit	†495,732	135,431	615,814
Previous surplus	521,429	385,997	‡229,817
Profit and loss surplus	1,017,161	521,429	385,997

*After deducting the cost of manufacturing, selling, taxes, insurance, development, redesigning and other general expenses, also dividends on preferred stock of The Bullock Electric Manufacturing Company and making adequate provision for doubtful accounts.

†Equal to 3.09 per cent on $16,500,000 preferred, as against eight-tenths of one per cent previous year.

‡Deficit.

President W. H. Whiteside remarks in part as follows:

"In an industry like that of this Company, which is largely the manufacture of heavy machinery requiring time to build, erect and test to completion, the results of each year must depend to a degree upon the previous year's demand. As noted in our previous annual report, business booked being, respectively, twenty-nine per cent and forty per cent in excess of the year ending June 30, 1909, and this improvement has continued during the past year, the sales invoiced and orders booked being, respectively, twenty-nine per cent and forty per cent in excess of the previous period. Of the sales invoiced for the year, about fifty-five per cent was for new lines of business which the Company has recently developed, and of these new lines about seventy-five per cent was electrical.

"While there has been an improvement in the earnings of the Company during the fiscal year, as compared with the preceding period, the various works have been operated at less than sixty per cent of their present capacity. Due to the unsettled business conditions of the country, there has been a very small demand for heavy machinery, which restricted the Company's operations largely to the lighter lines, and thus necessitated considerable development of new lines and types of the smaller machinery, for which there has been a fair demand."

Exports and Imports for 1910.

The excess of exports of merchandise over imports in the United States for the first nine months of 1910 amounted in value to $50,535,298. However, in the same period last year the excess was $92,430, 554 and in the 1908 period $432,269,181.

CHECK VALVES FOR FIRE PUMPS.—Two fire pumps are to be connected to the same main pipe line with a screw valve and a check valve in the connection between each pump and the common T-fitting in the main. Should the check valve be on the pump side or main side of the screw valve in each case?—J. M. W., Portsmouth, Va.

If the check valves were to be used merely for protecting the pumps from the back pressure of the main pipe line, then a single check valve in the main pipe will answer the purpose. In this case it is evident that the checks are to be used for this purpose and also to enable either pump alone to be run and the other to be started for extreme emergency only. This will be accomplished by putting the checks either on the pump side or line side of the screw valves. The latter position, however, is preferable because, in case pump A only is working, the screw valve of B is relieved of the pressure of A and therefore can be opened more easily if B also is to be started up.

STEAM POWER VERSUS WATER POWER.—Please give me the cost of producing electricity by steam and by water power.—C. B. G., Brooklyn, N. Y.

The cost of generating electricity by water power is almost always much less than the cost of generation by steam power. The actual cost depends in each case on many factors, such as the cost of fuel, the percentage of the fixed charges per unit of output, the distance of the water power from its market, etc. What is believed to be the lowest cost of steam-electric power is in one of our largest cities, where a great central station using steam turbines and cheap coal sells electricity in bulk to traction companies at close to $38 per horsepower-year (6,535 kilowatt-hours). The lowest waterpower cost known is at a Norwegian hydro-electric plant having a large output but very low investment charge and, of course, low operating cost; in this plant the cost per horsepower-year is about $4. What are more nearly average figures are those of the Hydro-Electric Commission of Toronto, which transmits Niagara power to many Canadian cities at an average annual cost of about $20 per horsepower, thus replacing a large number of steam plants where the average cost was about $60 per horsepower-year.

DYNAMO AND MOTOR QUERIES.—How can oil-soaked field coils be repaired? 2. How can the magnetic hum of a direct-current motor be stopped? 3. How many amperes will graphite brushes carry per square inch? 4. Is white mica or amber mica better for commutator segments? 5. Is there any firm that makes brush-holders?—L. M. Chicago.

1. If the oil has not become gummed it may probably be removed by pouring gasoline over the coil, and when this has drained off the coil should be dried out over a moderately hot steam or electric radiator, but not over any flame. 2. The hum of a direct-current motor is almost entirely of a mechanical nature due to the rubbing of the brushes and to windage or air currents entrained by the ends of the armature windings, the spider, armature teeth, or other uneven armature surfaces. The hum of the brushes is greatly reduced by making the commutator perfectly smooth and keeping it clean, also by fitting the brushes true to the commutator surface. Aside from the slight noise set up by the brushes, the motor would run strictly noiseless if its armature were a smooth closed drum. Therefore, if the hum is due to windage the ends of a small armature may be covered with canvas firmly held in place and shellaced. 3. About sixty amperes per square inch may be allowed for graphite brushes. 4. White mica is too hard for use in commutators; it does not wear down as rapidly as the copper segments. Therefore, the best quality of amber mica, which is much softer, should be used. 5. Practically every firm that makes dynamos and motors, also makes the brush-holders for them.

MINIATURE LAMPS RUN BY IGNITION BATTERIES.—I usually have a number of ignition batteries stored in my garage for the winter. Could these be used for lighting small electric lamps for Christmas trees?—J. S., Duluth, Minn.

Miniature lamps for Christmas-tree use can be lighted from an ignition storage battery under favorable conditions. Such batteries usually have three cells and give six volts, so that the lamps to be used must be six-volt lamps wired in parallel across the battery. If the battery has but two cells, four-volt lamps must be used. Tungsten miniature lamps will put a considerably less drain on the battery and therefore permit either more lamps to be used or the same number as carbon-filament lamps to be used about three times as long before the battery becomes exhausted. The lamps should be purchased from an intelligent supply man, who can calculate how many of a particular type can be used with an ignition battery of a known ampere-hour capacity; in this determination the exact current required by the lamps must be known. It is to be noted that an ignition battery is ordinarily discharged at a very low current rate and that for this tree-lighting service the battery capacity will not permit it to light the lamps more than from six to twelve hours, depending on the number and type of lamps used.

Low-pressure Turbo-generators for Copper Mines.

The Quincy Mining Company, operating in the Lake Superior copper district, is meeting with great success in utilizing exhaust steam from its reciprocating engines for driving low-pressure turbo-generators. The current is used for the rock houses, underground haulage, milling machinery, etc.

The Doherty Medal.

It has been officially announced that the competition for the Doherty medal closes on December 31 next. This medal is awarded annually for the best paper read before any Company Section of the National Electric Light Association. W. C. L. Eglin is chairman of the Committee of Award.

New Electrical and Mechanical Apparatus and Appliances.

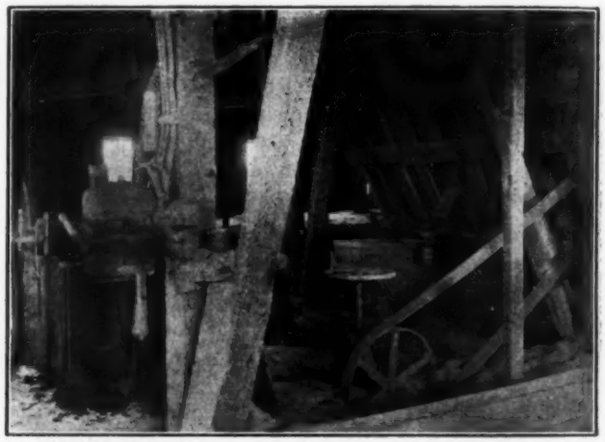
Motors Serve Well Under Severe Conditions.

That electric motors can be operated successfully under very severe conditions is forcibly demonstrated by the accompanying pictures, which were taken in the fertilizer works of G. Ober & Sons, Baltimore, Md. As a result of the Company's fifty years' experience in the manufacture of fertilizer the motors were installed about five years ago; since that time they have been working under triple combination of difficulties: sulphuric acid fumes, dust and grit, and crude operatives. Under these conditions the motors have given very satisfactory service since they were installed and they have justified their adoption.

The operations of grinding the bone and phosphate rock that are used in the making of fertilizer make great quantities of dust, which settle everywhere in the plant and cover the machinery with a dirty, gritty mantle; the photographs are typical of the appearance. Besides the grit, sulphuric acid fumes permeate the air; this acid is used in the manufacture of phosphoric acid from phosphate rock. The operatives are recruited from negroes and the less intelligent class of whites; their appreciation or knowledge of machinery is very slight and their usage of it is likely to be rough.

But for all these abuses the motors are operating as smoothly as when they were installed over five years ago. The motors are of the polyphase induction type, made by the Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa. Polyphase induction motors of the squirrel-cage type offer distinct advantages for an installation of this kind. The absence of sliding contacts makes possible extremely simple construction, with no wearing parts except the bearings. Absolute freedom from sparking is assured; the motors can be used with perfect safety in locations surrounded by inflammable or explosive material. The line connections are made to the stationary element when the motor is installed, and no further connections are necessary. The rotating element is practically indestructible. Simplicity of construction and operation, and low cost for attendance and maintenance, are among the marked advantages of this type of motor.

VIEW OF MOTOR WORKING UNDER SEVERE CONDITIONS.



MOTOR ON LEFT PRACTICALLY COVERED WITH REFUSE.

The Waverley Chicago Branch.

The success of the Waverley electric vehicle agency in Chicago has led to the opening of a Chicago branch of the Waverley Company temporarily at 1714 Michigan Avenue, but soon to be moved to new quarters farther south on the same street.

In charge of the new branch will be Manager J. C. Cooley, who has been identified with the Waverley electric vehicle agency since its inception. Mr. Cooley will be ably assisted by W. H. Corris and an adequate force of salesmen and demonstrators. A force of technical men will also be present.

A Striking Installation of Meter-Connection Blocks.

The accompanying illustrations form an interesting commentary on the utilization of meter-connection blocks in installing service and meter equipment in the modern apartment house.

For the protection of the customer, as well as the operating company, it is extremely desirable that a permanent meter location be provided in which the wiring and meter are so arranged that they present a sightly appearance, allow the meter to be readily connected and disconnected from the service for purposes of test or renewal, and protect the service wires and fuses from illegal or undesirable manipulation.

The various meter-connection devices manufactured by the Hart Manufacturing Company were designed to provide the above-mentioned features, and in addition, to arrange for an indicating service switch that can be operated by the customer without exposing any of the connecting wires, or service fuses. This line of connection blocks is suitable for use with all types and capacities of meters.

The accompanying illustration, Fig. 1, is a photograph of a meter setting in a large apartment house, that was recently remodeled, supplied with meter-connection blocks.

Fig. 2 illustrates the arrangement of meters in this building before its equipment was brought up to date.

This line of meter-connection blocks

consists of a metal cabinet which encloses the meter and a combination test and fuse block. The line wires

FIG. 1.—METER SETTING IN AN APARTMENT HOUSE.

are brought into the fuse block, then through the switch to the meter, and from there to the customer's load, the arrangement of the fuse blocks being

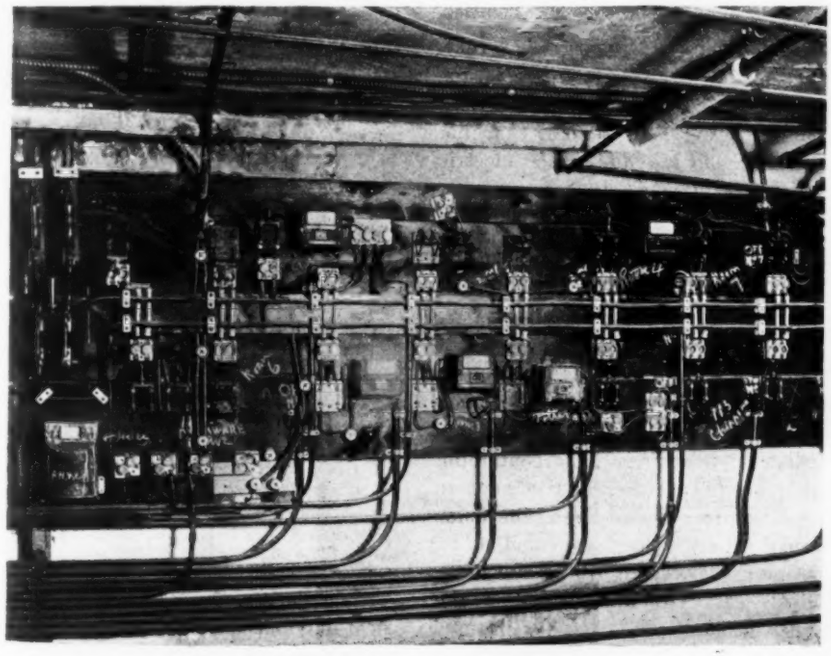


FIG. 2.—VIEW BEFORE INSTALLING BLOCKS.

such that it permits of the meter being tested on either an artificial or the customer's load without interrupting the customer's use of current, or making any other operation necessary than screwing two test plugs into their proper receptacles on the block, these test plugs being provided with cords that attach to the testing instruments. The steel cabinet is arranged to be sealed, so that the fuse, block, switch, meter and connecting blocks are protected.

A New Rectifier Outfit

The mercury-arc rectifier provides a very convenient and efficient means of transforming alternating current to direct current and is meeting with a wide application in this field.

This device is used extensively to charge the batteries of electric automobiles, and the General Electric Company's Universal battery-charging rectifier outfit has met with great favor. It is complete with voltmeter, ammeter and protective devices and is so designed that it is suitable for a wide range of voltages and for current capacities ranging from 10 to 50 amperes.

To meet the demand for a less elaborate panel, the General Electric Company has recently placed on the market a rectifier designated as the "Runabout Type." This new rectifier is made up without voltmeter or ammeter. It is, therefore, recommended only for use with cars that are equipped with a first-class voltmeter and ammeter. It is designed to charge batteries consisting of from 20 to 32 cells at a maximum charging rate of 30 amperes.

The "Runabout Type" rectifier has one important advantage over the Universal type—its extreme simplicity. As will be noted above, its range is limited to 20 to 32 cells, while the Universal type will charge from 5 to 44 cells of lead-plate battery. Therefore the former does not require special and elaborate means of adjusting current and voltages. It has only one small dial switch which gives a range of fine regulation sufficient for any battery from 20 to 32 cells. This means a simplicity not possessed by any other battery-charging rectifier set and will make the set appeal to the many men and women who want to charge their own electrics, but perhaps hesitate to tackle the slightly more complicated appearing Universal type.

Figs. 1 and 2 show front and rear views of the new rectifier. This outfit is self-supporting. The panel pipe supports are screwed into suitable receptacles on the compensating reactance which is of sufficient weight to hold up the rectifier panel and its equipment.

The outfit consists of four essential parts, rectifier tube, compensating reactance, regulating reactance and panel with supports.

The tube is mounted in a holder located on the back of the panel. The

shaft of the holder extends through the panel and is connected to a hand wheel on the front, by means of which the tube is tilted when starting the outfit. Fig. 2, which shows the back view of the rectifier panel, illustrates the form of the tube holder. Particular attention is called to its simplicity and to the evident ease with which a tube can be inserted.

The function of the compensating reactance is to maintain the arc in the tube while the alternating current is passing through the zero point of the cycle. This reactance is so arranged that one lead is a negative pole of the rectified current, while the other leads are arranged so that the reactance can be used as a compensator (thus its name, compensating reactance) so that by a few changes the outfit can be used on either 110-volt or 220-volt alternating-current supply circuits and be able to charge a maximum of thirty-two cells.

Fine regulation of the direct-current

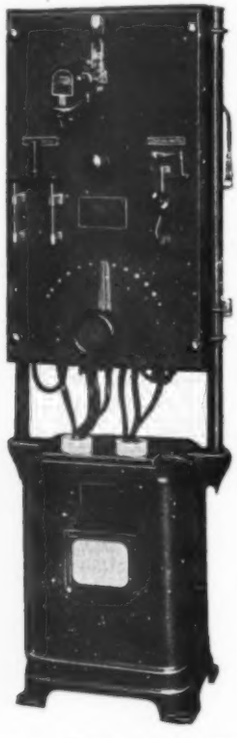


FIG. 1.—RECTIFIER PANEL.

voltage is accomplished by means of a regulating reactance which is connected in the alternating-current line. This reactance consists of a coil wound upon one leg of a rectangular laminated core. The coil has eleven taps, which are connected to studs on a dial switch mounted on the front of the rectifier panel.

The rectifier panel is of natural black slate 28 by 16 by 1.5 inches, and it is equipped with all switches necessary

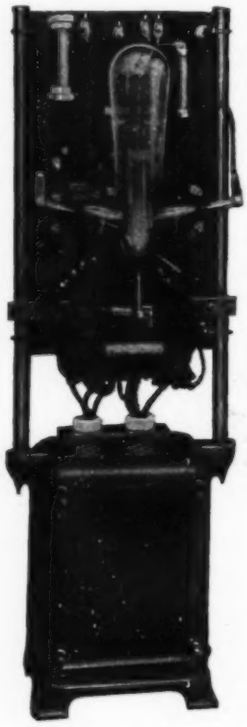


FIG. 2.—REAR VIEW OF PANEL.

for the operation of the rectifier and the regulation of the charging current.

This simple, compact and inexpensive rectifier outfit will be found to be satisfactory in every respect for charging electric runabouts and other electric vehicles that have about the same number of cells and no doubt it will come into extended use in this connection.

Electrolytic Lead Refining.

A description of a lead smelter and refinery is given by J. M. Turnbull in *Mines and Minerals*. The tanks are lined with asphalt and the electrolyte consists of lead fluosilicate containing free fluosilicic acid, which is kept in circulation by pumps. Each tank holds twenty anodes, which are handled by a crane. They weigh 370 pounds each, and are cast with lugs to rest on the copper busbars.

The cathodes are sheets of pure lead, also hung from copper bars. There are twenty-one in each bank. A current density of sixteen amperes per square foot is used.

Electric Fire Whistle.

Everett, Mass., boasts of a fireman-inventor, Capt. Obed De Champ, who, by his ingenuity has saved the city considerable money, besides making possible several new mechanical devices. His latest addition to the fire-alarm system of Everett is an electric whistle. This whistle works somewhat upon the principle of a telephone receiver. A diaphragm of considerable size is caused to vibrate rapidly by the use of sixteen small coils placed inside the framework. The volume of sound may be increased or decreased, either by increasing or decreasing the size of the diaphragm, or by adding to or taking from the number of sections which compose the whistle.

The one prepared by Captain De Champ for use in Everett has diaphragms about ten inches in diameter and is made up of eight sections, as shown in the illustration. Each section contains a diaphragm and is a complete whistle in itself, only giving less volume than the whole eight sections together. When in position the

ELECTRIC FIRE WHISTLE.

working parts are encased in a cylindrical galvanized covering, open at the top, which will concentrate the sound in great volume at the top. It is said to be the only whistle of the kind in the country, though Captain De Champ is now at work on a similar one for the

fire department of Athol. It was invented by Captain De Champ at the request of the city authorities, who found that other whistles that had been depended upon, connected with some large factory buildings, had been put out of commission. They found that a compressed air whistle would cost about $2,500 complete and would take up a large space for the four storage tanks.

A New Snap-Shell Socket.

A new snap-shell socket which permits the cap and shell to be snapped together in any position, which will hold firmly in all of these positions, and which may be easily opened is being placed on the market by the H. T. Paiste Company, Philadelphia, Pa.

The two accompanying illustrations show a key socket and a pull socket of this new type. On the shell of the socket are two heavy catches which slip into the specially formed channel in the cap. The supporting edge of this channel is formed on an angle so that the ordinary strains and pulls on the shell cause the heavy catches to hold tighter.

To provide against the shell turning in the cap when they are locked together, there are two small lugs in the cap which enter the proper square recesses in the shell and the whole is held from turning just at the point desired.

To take the socket apart the shell

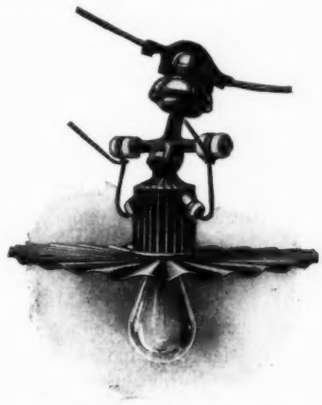
TWO TYPES OF SNAP-SHELL SOCKET.

needs to be pressed at a point so marked and by an opening motion the cap and shell are easily disengaged.

It is evident that this snap-shell socket is a labor-saver, for besides being easily taken apart for wiring, its method of attachment to the fixture is most simple. The cap is first screwed to the fixture and secured by the set screw in the usual manner; after the movement is wired up, the shell is inserted into the cap about one-sixteenth of an inch and then the handle rotated to the position desired, and with a little further push on the shell it locks.

"On the Level" Street-Lighting Fixture.

The Elmer P. Morris Company, 86 West Street, New York, N. Y., manu-



"ON THE LEVEL" FIXTURE.

factures of specialties, has recently brought out a central-suspension street-lighting fixture of novel design.

This is known as the "On the Level Street Lighting Fixture," and it is so constructed that the reflector will always remain on the level, as its name implies.

With the improvements which have been made in recent years in both lamps and reflectors, it becomes more and more important to obtain the desired results with these devices and undoubtedly, one of the most important is that the reflector remains in a horizonal posiion.

When using the ordinary type of reflector, centrally suspended, they are rarely level, owing to the strain of leading-in wires or owing to the fact that suspension wires are not level. The "On the Level Fixture" shown in the accompanying illustration is designed to overcome this trouble.

The cross-arms are placed upon the holder and not upon the reflector. It will be seen from the illustration that even with unusual strain the reflector remains level.

The sockets above the reflector are protected by porcelain bushings and no bolts or plugs are necessary to make connection to span wire. The enameled reflector does not come in contact with other metal parts and troubles from chipping are eliminated.

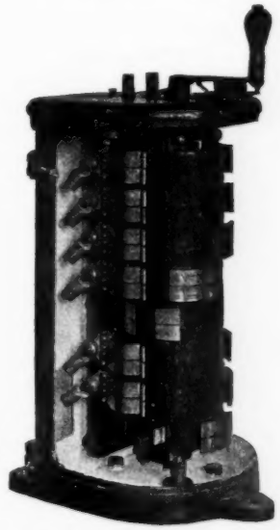
Drum-Type Starters for Alternating-Current Slip-Ring Motors.

Owing to the extended use of alternating-current motors the demand for starting apparatus has increased. The motor applications are also made under conditions requiring proper starting and acceleration.

When starting under load the slip-ring type motor is much preferred to the ordinary design of the squirrel-cage motor. To get the desired acceleration a starter is needed which in the case of motors of considerable size, can handle large currents and can also be safely and easily operated.

For motors of moderate capacities the Cutler-Hammer face plate type is practicable but for large motors the new drum type illustrated herewith is preferred. For use in industrial plants and where subject to dust, lint, etc. it is especially adapted as there are no exposed contacts. The standard sizes manufactured range from ten to 200 horsepower.

The drums are tightly fitted and constructed of the best material throughout. The contacts and brushes are made of hard-drawn copper and can be readily and cheaply renewed.



DRUM TYPE STARTER WITH COVER REMOVED.

The cylinder on which the contacts are mounted is built to remain perfectly true under all conditions.

This type of apparatus can be handled by any workman without danger of accidental contact or other trouble. The cutting out of the resistance, and the acceleration can easily be controlled. All connections are made inside the drum.

Effective Grounding in Telephone Train Dispatching.

Since the closing of the series of articles on "Telephone Train Dispatching," by K. W. Endres, we have received some interesting information on grounding from the Paragon Sellers Company, Chicago, Ill., relating to the Paragon ground cone, which is being used very extensively in this class of service.

Lightning arresters cannot do their work properly unless they are grounded in a way so that they may take care of any charges that come over the line. A lightning protector must guard the apparatus not only from the low voltage crosses as when they become crossed with lightning or power wires but also with the high voltage, oscillating current induced by lightning charges. It is extremely necessary therefore, that the lightning protector be built properly and be grounded properly.

With this idea in view, the Paragon Sellers Company has developed the Paragon ground cone to a point of efficiency which is marked. The ground is conical in shape; it is made of solid copper and the lateral surfaces are perforated—seventy-five perforations to the square inch. The cone is then filled with charcoal and the upper cap is securely soldered to the cone itself. The perforations in the sides provide for the accumulation of moisture as charcoal is quite hydroscopic and also provides a very large brush discharge surface.

The cone is equipped with a hollow copper cable of 61,968 circular mills cross section and the ground wire is run inside of this cable to the point of the cone; this on the one-foot cone provides about eighteen inches of copper contact, on the two-foot cone about thirty inches of copper contact. The harder the pull on the cable, the tighter it laces down to the ground wire working on the same principle as the cable grip.

The cone as indicated above, is a self-contained grounding device; no extra work need be done it by the wireman or the installer and he merely has to bore a hole into moist earth, attach his ground wire as indicated above, drop in the cone and a perfect ground is obtained.

In locations where there is lack of moisture or where the soil drainage is excessive as is the case of soils made up of sand, gravel or glacial drifts, it is sometimes advisable to surround the cone with charcoal or crushed coke; ordinarily, however, this extra protection is not needed.

This whole matter of grounding is receiving attention in the last few years in a way that it never did before and the Paragon Sellers Company in bringing out this ground cone has made a long step in the right direction.

New Holophane Steel Reflectors.

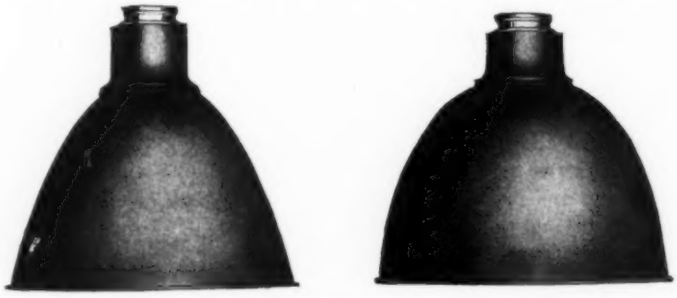
It is not often that a manufacturing concern, whose goods rank as the best of their class, is able to improve that product by almost one-third, but that is what the Holophane Company has done with its line of Intensive and Extensive steel reflectors.

About a year ago the Holophane Company, anticipating the need of both better practice and better equipment for mill and factory lighting, placed upon the market its extensive and intensive type steel reflectors, these being the first scientifically designed metal reflectors available for Mazda and tungsten lamps. The development of industrial lighting has become so important that already specialists have entered the field who are devoting their entire time to it.

The Holophane Company, however, has not been content to rest its reputation entirely upon the first Holophane-D'Olier reflectors produced for this service, and set about redesigning and perfecting the Company's product. The results of this work are now offered to the trade.

The new Holophane-D'Olier steel reflectors give an average increase of thirty-one per cent in illuminating efficiency, this increase being practically the same for both the intensive and extensive types, and not only is this remarkable increase in efficiency effected, but the distribution of light is much more advantageous and the new reflectors may be installed on exact spacings with the same certainty of obtaining uniform illumination as is the case when Holophane glass reflectors of the standard types are employed. A third advantage, and one which will be recognized instantly by all who are familiar with industrial-lighting requirements, is that the angle of cut-off is as low as can practically be secured, thus reducing glare effect to the minimum. In appearance, the new Holophane steel reflectors are attractive, while in quality of material and workmanship they leave nothing to be desired.

The Holophane Company is giving deep study to the subject of industrial lighting in all its phases and maintains a special bureau, directed by E. E. Scribner, which is devoted exclusively to this branch of illuminating engineering. As in other departments of lighting, the Company offers the services of its industrial engineers without charge to central stations, contracting engineers or consumers who may desire their co-operation in solving mill or factory-lighting problems.



TWO NEW TYPES OF HOLOPHANE STEEL REFLECTORS.

New Building at Purdue University.

The new building for the Department of Practical Mechanics at Purdue University was dedicated on November 12. The building was completed in June. It contains 25,000 square feet of floor space, and includes a lecture-room, class rooms, shops and drawing-rooms.

Addresses were made by President W. E. Stone, Dean, C. H. Benjamin and Hon. M. W. Mix, after which lunch was served and the buildings inspected.

Liquid sulphur dioxide can be purified by the passage of electric current at high potential, according to J. Carvallo in a paper read before the Paris Academy of Sciences.

Current Electrical News

GREAT BRITAIN.

(Special Correspondence.)

LONDON, NOVEMBER 4.—The fight between the municipalities and the Electrical Contractors' Association is being continued and everything points to a keen struggle in Parliament next session. For the moment both sides are strengthening their forces as much as possible, the Municipal Electrical Association making much of the fact that the large majority of municipal electrical engineers do not wish actually to use the wiring powers. The view is held that the mere possession of wiring powers will have the effect of keeping the contractors more keen than they are at present in many places. So many corporations are promising financial support to the proposed bill that it would not be a great surprise if the question of the legality of such a proceeding is challenged.

The prices of wiring work are being cut so fine, mainly due to former employees of contracting firms taking on jobs for themselves, that the Electrical Contractors' Association is endeavoring to evolve a standard of work, which shall stamp its members with a special mark of efficiency. It is doubtful whether the Association is sufficiently strong numerically to do this effectually and in any event care must be taken to prevent this being used to inflate prices, which would defeat the whole object at once. At the same time, a better standard of wiring is undoubtedly necessary, taking wiring work as a whole.

Mr. Marconi is said to have under consideration a new design of aeroplane particularly adaptable for wireless telegraphy. He has also stated to an interviewer that he may even take to flying himself in order to attain the object he has in view.

The Bournemouth Corporation has decided, finally, to abandon the conduit system of electric traction and to have overhead. Bournemouth was the first place in the United Kingdom to adopt a combination of conduit and overhead tramways, which was lauded at the time as the ideal system, for a town with narrow streets.

J. H. Rider, chief electrical engineer to the London County Council, tramway department, recently resigned to accept an important post in South Africa. In consequence of Mr. Rider having completed the design of the power house and electrical arrangements generally for the London tramways, it has been decided to abolish the position of chief electrical engineer and to have an electrical assistant under the chief officer of the department.

Following the example of the Holburn Borough Council, the City of London Corporation has arranged a competition between gas and electricity for street lighting. The gas companies do not suffer from any compunctions in copying what the electric lighting companies do, for they have now arranged some lamps strung across Cannon Street on wires, the gas being carried by flexible tubing.

The Postmaster General's annual report mentions the steps that are being taken to establish a ring of wireless telegraph stations around the coast. Another feature of the report is the evidence that telephoning is appreciably reducing the number of letters written by business firms. New telephone subscribers are being connected up at the rate of 150 per week, the total increase last year being 9,100. G.

CONTINENTAL EUROPE.

(Special Correspondence.)

PARIS, NOVEMBER 3.—The new Paris subway line running from north to south across town is shortly to be opened, at least for nearly the whole length. It makes transfer connections with the Metropolitan subway at four different points, one of these being at the St. Lazare Depot. The line, known as the North-South subway, will at present be operated between the Versailles Gate and the station of Notre Dame de Lorette, taking in the business quarters in the center of town. As will be remembered, the double-track electric line uses trains made up of motor cars and trailers and runs in a single tunnel except where it crosses under the Seine, and here a separate iron tube tunnel is used for each track. The Municipal Commission has just made an official visit to the line, and it will be opened to the public early this month. The official inauguration of the subway is fixed for November 4. It will be appreciated by the public, as it was needed for some time past, especially in certain districts, and will add to the already well-developed system of subway lines. Within a few years, when the work upon the present plans is carried out, Paris will have no less than seventy miles of subway.

The annual report of the Triphase Company, of Paris, was issued not long since. This firm operates one of the large electric plants, which is located in the suburbs, and it furnishes current for a part of the city underground mains, as well as for the suburban districts. Although the Company recently installed two 6,000-kilowatt steam-turbine alternator groups and a new battery of six boilers for running these machines, it proposes to make a further increase very shortly, as this will be needed. The Company has been operating its present plant for the last ten years.

I note the decease of two engineers who are well known here, one of these being M. Maurice Levy, member of the Institute. He was connected with the Creil-Paris power-distribution line and plant in 1886, this being the first attempt of the kind in France. Since then he has been prominent in electrical circles. Engineer O. Helmer was first connected with the Cail Company, the large engineering and electrical firm, and afterwards with the Creusot metallurgical works and manufacturers. In both cases he was engaged in dynamo designs, and brought out a number of improvements.

In Holland there is to be run an electric tramway line between the towns of Zuidbroek and Ter Appel. The roadway of the former Auimal traction line will be used. Among other traction projects, I note that the city of Rome has lately ordered a number of motor-car outfits and new materal for substation increase. A suburban traction line will also be constructed between Milan and the towns of Pacello and Cremo, taking in a number of communes. The contract has been granted to the Italian Edison Company. In north Italy, an electric road will be run between Intra and Premero, in the lake region. It is especially designed for tourist traffic. Trains are now running on the electrical section of the Seethal railroad line in Switzerland. The service is commenced with passenger trains, but it is planned to run freight trains very shortly.

The question of using electric trains on the railroad system for the western suburbs of Paris has been brought up repeatedly, but the problem is a very difficult one to solve. The West lines belong to the State, and the city terminus is the St. Lazare depot. It is now proposed to adopt electric traction on the whole of the suburban system at a cost of $20,000,000, the whole work to be finished within three or four years. A heavy passenger traffic is carried on these lines, hence the need of a solution of some kind very soon. The discussion of such a project will naturally take some time before coming to a decision. A. DE C.

CANADA.

(Special Correspondence.)

OTTAWA, ONT., NOVEMBER 12.—It has just been decided by the Ontario courts that the lines of the Ontario Hydro-Electric Commission, being in the nature of public property, do not come under the law respecting municipal taxation. A privately owned competing plant, however, has to pay the limit of such taxation.

The Street Railway Company of London, Ont., has notified the Hydro-Electric Commission that it cannot accept the Commission's offer of power on a twenty-four-hour basis. The Company says that it must have the power by meter, or it will have to extend its own power plant and give up all idea of taking Niagara power.

The Railway & Power Company, of Sherbrooke, Que., has secured permission from the Ascot Municipal Council to erect poles for transmission of power from the Company's plant in Sherbrooke, to Capeton mines, a distance of eight miles. Other industries are now negotiating for power along the same route.

The Bell Telephone Company of Canada will ask the Dominion Railway Commission, on December 12, next, to sanction a new schedule of rates. At present, the business rate is $50 a year, and the residence rate $30, as applied to the city of Toronto. It is proposed to raise these to $55 and $35. The application will be opposed by the City, as it would mean an increase of some $150,000 a year.

The Ontario Government has under consideration the extension of the hydroelectric transmission line from St. Thomas to Windsor, a distance of 120 miles, and it is estimated that the work would cost over $1,000,000. The City of Windsor has made application for 15,000 horsepower, with authority to export about 12,000 horsepower to Detroit. Other new transmission lines, in western Ontario, are said to be contemplated.

The subcommittee on water and hydraulic forces, of the Canadian Conservation Commission, has just finished a long summer's work on the subject of the water powers of Ontario and Quebec. The figures show that Ontario has a right to 3,724,000 horsepower of her waterways. Of this the Ottawa River and the St. Lawrence River district can generate 946,000 horsepower. The total amount of power that would be used at Niagara, by using all the water, and drying up the falls, would reach over 1,500,000 horsepower. Northern Ontario, alone, aggregates 1,730,000 horsepower in its various rivers and falls. W.

COMMISSION NEWS FROM NEW YORK.

(Special Correspondence.)

Contractors' bids on the three divisions of the Triborough subway, which were advertised last summer by the Public Service Commission of the First District, were made public in tabulated form by that body. The total of the lowest bids on the twenty-one sections embraced in the three divisions amounted to $85,437,570, which is some $3,000,000 in excess of the estimates of the Commission's engineers as to what the construction ought to cost. The three divisions are: The Broadway-Lexington Avenue subway in Manhattan, the Canal Street crosstown link in Manhattan, and the Broadway-Lafayette Avenue subway in Brooklyn.

The Public Service Commission has determined to make an investigation of the telephone charges collected by the New York Telephone Company for the transmission of messages between the Borough of Manhattan and the boroughs of Brooklyn, Queens, The Bronx and Richmond, and each of them, and to determine whether such tolls are unjustly discriminatory or unduly preferential or in anywise in violation of law, and as to whether or not it shall determine the just and reasonable rates and charges to be hereafter observed and in force as the maximum to be charged, and as to whether these shall be other than the rates now charged. The Company is required to appear before the Commission at the Engineering Society's Building, New York, on November 28, and submit evidence and arguments as to the matters which are to be investigated. The complaint of the Prospect Park, South Association, of Brooklyn, asking the Commission to investigate the rates charged between Brooklyn and Manhattan, will also be considered.

COMMISSION NEWS FROM WISCONSIN.

(Special Correspondence.)

The Railroad Commission of Wisconsin has authorized the Monroe Electric Company to issue the following stocks and bonds: Twelve shares of common stock of a par value of $100 each. These shares to be sold for money only and at not less than par value. Also $4,000 par value of bonds of denomination of $500 each, interest at six per cent, payable semiannually. These bonds to be sold for money only and at not less than seventy-five per cent of par value. These bonds are to be used to supply the Company with funds for paying outstanding indebtedness incurred by additions and extensions to the plant.

The Commission has been taking testimony in the matter of the application of the Kenosha Electric Railway Company for a certificate of public convenience and necessity. The evidence introduced by the City of Kenosha and by the Kenosha Electric Railway Company was intended to show that conditions generally make it a public necessity that the Kenosha Electric Railway Company be permitted to conduct a regular electric lighting and power business in Kenosha.

The Commission has made a report to the Evansville Municipal Electric Light Plant covering an investigation of the rate schedules now in force in Evansville and the question of the giving of a day power service in that city. This report is not the result of complaints by consumers in Evansville, but arose from a request on the part of the municipality that the Commission investigate informally the situation in Evansville and recommend the future policy of the plant as regards rates and the installation of a day service. The Commission pointed out that the present rate schedule is open to the fatal objection that the sliding scale now in force creates discrimination between consumers. Under the present schedule it is possible for a certain consumer to have a larger bill for service than another consumer whose meter shows the use of a larger amount of current. It was also noted that the schedule in use makes a distinction between residences and stores. Where the primary rate for residences is fifteen cents per kilowatt-hour and drops to a rate of ten cents where the monthly consumption reaches thirty kilowatt-hours, the primary rate for store lighting is ten cents per kilowatt-hour and drops to eight cents where the monthly consumption reaches forty kilowatt-hours. The Commission pointed out that this form of schedule recognizes only the quantity of current consumed and gives no recognition to the fundamental factors of demand and hours daily use of the connected load. The Commission recommended the use of rate schedules as follows:

COMMERCIAL LIGHTING: Twelve cents per kilowatt-hour for the first thirty hours use per month of the active connected load; nine cents per kilowatt-hour for the next thirty hours use per month of the active connected load; six cents per kilowatt-hour for all current used in excess of sixty hours use per month of the active connected load. The following percentables of full connected load to be considered active: Class A, residences, rooming houses and public buildings—forty per cent active; Class B, churches, schools and industrial establishments closing not later than 6 p. m.—sixty per cent active; Class C, offices, stores, laundries, livery stables, hotels, restaurants, theaters, lodge halls, bowling alleys, depots and all other consumers not herein specifically provided for—seventy-five per cent active.

COMMERCIAL POWER: Fifty cents per month for each horsepower of nominal rated capacity of motor or less. Current charge, eight cents per kilowatt-hour for all current consumed. Minimum monthly bill to be seventy-five cents.

LIGHTING AND POWER.

(Special Correspondence.)

MACON, GA.—The Brown Wagon Company has awarded a contract to the Central Georgia Power Company to furnish electric current for the operation of its plant. B.

LOWELL, MASS.—The committee on lighting which met recently recommended the installation of a number of new arc and incandescent lights throughout the city.

DOUGLASVILLE, GA.—This city will vote November 28 on the issuance of $20,000 of five per cent thirty-year bonds for electric lighting plant. The mayor should be addressed for information. B.

DUBLIN, GA.—Dublin will vote on December 6 as to the issuance of $30,000 bonds. It is proposed, if the bonds carry, to issue $25,000 bonds for improving the lighting and water plant and $5,000 for paving.

WAYCROSS, GA.—At a meeting of the directors of the Ware County Light and Power Company in New York City, Stuyvesant Fish was elected president, B. Loomis, Jr., vice-president, and C. S. Hammett, superintendent. B.

MOUNT VERNON, O.—The Mount Vernon Electric Company has increased its capital stock from $10,000 to $300,000. According to the papers filed with the Secretary of State, $175,000 of the increase is preferred stock.

CARBONDALE, W. VA.—The Sunday Creek Company of this place has placed an order with the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., for one 200-kilowatt, 250-volt direct-current engine-type generator.

RICHMOND, VA.—The Committee on Streets has recommended the granting of a franchise to the Richmond Power Corporation. It is proposed by the Company to sell power generated by a plant located at the Midlothian coal mines in Chesterfield County.

NEWMAN, GA.—The Hill Power Company has been incorporated with $50,000 capital stock by S. L. Hill, L. H. Hill and H. G. Glover, of Newman; W. O. Jones, of Elberton, Ga., and W. K. Stringer, of Anderson County, S. C. This company proposes a hydroelectric development. B.

BLOOMER, WIS.—It is reported that a contract has been closed between the local electric light plant and the Eau Claire Light & Power Company for electricity to light the village. Work on building the line has already commenced, and it is expected that the power will be supplied by December 1.

CHARLESTON, S. C.—The work of building the foundation of the power house at the foot of Charlotte street is about fifty per cent completed. Piles which are being driven in the water are to be sawed off, capped and surrounded by a concrete wall. The station is then to be erected on this structure.

GRIFFIN, GA.—To exhibit its enterprise it is stated that the Central Georgia Power Company will furnish Griffin, Ga., sufficient electric current free for an electric sign to be placed on top of a new hotel. The sign may consist of the words, "Gem City of Georgia." The proposition has been accepted with much thanks by Griffin. B.

DES MOINES, IA.—Improvements on the Des Moines Electric Company's plant on the river front near Center Street that may involve an expenditure of $70,000 are being planned by Paul B. Sawyer, general manager of the Company. Although no definite work has been authorized, it is expected that the Company will rebuild the old section of the plant in the spring.

AMERICUS, GA.—In the election November 8, for issue of $65,000 municipal improvement bonds, the issue was defeated for lack of two-thirds vote. General disappointment is expressed. Another election will be called shortly and repeated if necessary until Americus is provided with the needed utilities, including municipal lighting plant and sewerage extension. B.

SPARTANBURG, S. C.—It is announced that the Electric Power and Manufacturing Company, operating here, will proceed shortly to increase its facilities locally, and also extend its lines to Gaffney, twenty miles north, establishing a substation there. The additional equipment will give about 2,500 added horsepower. Many cotton mills in the section surrounding are using the Company's current. L.

LEAD, S. D.—The Homestake Mining Company of this place has just placed an order with the Westinghouse Electric & Manufacturing Company of Pittsburg, Pa., for three 3,000-horsepower double overhung Pelton water wheels, three 2,000-kilovolt-ampere alternating-current generators ten 667-kilovolt-ampere oil-insulated water-cooled transformers, two 100-kilowatt three-bearing motor-generator sets, and one complete switchboard.

SAN FRANCISCO, CAL.—Announcement has been made that the Pacific Gas & Electric Company, the largest distributer of electric energy in California, has contracted with the Great Western Power Company of San Francisco and New York to purchase from the latter Company at a fixed price all the electric current that it can produce for a long term of years. The Great Western Power Company is now carrying a load of approximately 40,000 kilowatts. A.

MACON, GA.—The completion of the large dam of the Cen-

tral Georgia Power Company, at Jackson, Ga., on the Ocmulgee River, is announced. The big basin is now filling with water and the plant will be ready for operation as soon as sufficient headway is gained to turn the wheels. The machinery is in place, transmission lines are up and the local officers of the Company are at work on final details. B.

NOBLESVILLE, IND.—In a petition filed in court by Jonas Gaar of Richmond, Ind., against the White River Light & Power Company, Ralph Beaton of Columbus, O., as receiver for the Company, asks the privilege of selling the plant at a receiver's sale. Judge Vestal has ordered the plant sold on December 19. In the event that the plant is sold for enough to cover all indebtedness of the Company it must bring $190,000. This Company is engaged in building a hydraulic dam across White River north of this city.

MONTGOMERY, ALA.—At the session of the Court of Appeals has come up the appeal case of Alex Rice, who lost in the suit of the Doherty Operating Company concerning the sale of the Citizens Light, Heat & Power Company to Richard Tillis. The case is vitally interesting to Montgomery, for it is stated that a monopoly would be established by the Montgomery Light & Water Power Company should Doherty win in the upper court as he has in the lower body. Briefs were submitted and arguments heard by Court of Appeals. B.

CHARLOTTE, N. C.—J. D. Pitts, of Glen Alpine, who owns and operates a large roller mill on Canoe Creek, four miles from Morganton has begun work upon a stone and concrete dam at his power site and has ordered equipment for a power house. The hydroelectric development will cost about $25,000, exclusive of the site and land to be covered by the lake, and will produce a minimum of 250 horsepower of electricity. A transmission line will be constructed to Morganton, where the power will be disposed of to small enterprises and used for lighting.

DUBLIN, GA.—The municipally owned water and light plant in this city is said to constitute one of the best paying properties here, the profits for the past year being set down at $8,200. The total income from the lighting department was approximately $30,000, not including sixty arc lights maintained, lights furnished free, etc., making the total revenue amount to $35,200. The operating expenses were $27,000, and the City is preparing to spend $25,000 in making improvements and additions to the plant, further increasing its earning capacity. L.

WADESBORO, N. C.—The sale of the hydroelectric power plant at Blewitts Falls, on the Cape Fear River, set for November 5, with an upset price of $1,000,000, has been postponed to the latter part of the month, and the upset price, it is understood, reduced to $750,000, as the first-named figure brought no bidders. A strong probability exists that the Southern Power Company will take on this plant, adding it with its 30,000 available horsepower to its other plants in South Carolina. The probable extension of the interurban electric lines, backed by the Southern Power Company largely, through the eastern part of North Carolina, places this plant convenient as an additional source of electric power for the long extensions mentioned. L.

SALISBURY, N. C.—The Whitney Company's extensive electric developments on the Yadkin River, in litigation for several years, and as yet incomplete, will be exposed to sale November 30, a final decree having been given at Asheville by Federal Judge J. C. Pritchard, in the case of the Bankers' Trust Company against the Whitney Company. The decree granted provides for the sale of the as yet unfinished plant, together with all of the Whitney properties involved, the Yadkin River Electric Power Company, the Yadkin Land Company, etc., John S. Henderson and Chas. W. Smith, receivers. The decree is to satisfy a judgment of $5,406,750 in favor of the Bankers' Trust Company, trustee, under mortgage made in November, 1904. It is further provided that the T. A. Gillespie claim of $344,976 for work done on the plant, dam, etc., shall be settled before the bondholders receive anything, also the cost of litigation, now amounting to $138,000, to come out of the funds. L.

NEW YORK, N. Y.—Henry L. Doherty & Company recently made an offering of Cities Service Company preferred stock at par with thirty-five per cent common stock bonus. The Cities Service Company is organized under the laws of the State of Delaware, and has contracts for the acquisition of all the common stock of the Spokane Gas & Fuel Company, of Spokane, Wash.; over ninety per cent of the total stock of the Denver Gas & Electric Company, Denver, Colo., and over ninety per cent of the common stock of the Empire District Electric Company, of Joplin, Mo. The Company will acquire in the future stocks of other desirable gas and electric and similar properties. The offer of $1,000,000 par value of preferred stock and $350,000 par value of common stock in blocks of $100 par value of preferred stock and $35 par value of common stock for $100, was closed at 12:00 o'clock, November 10, largely over-subscribed. Owing to delay in the delivery of a portion of the list to which the subscription offering was sent, the Company has made a subscription for $100,000, which it will turn over pro rata with all subscriptions received prior to November 21. Henry L. Doherty is president of the Company and the Doherty Operating Company will continue to work to the development and efficiency of the properties of the holding company and the subsidiary companies of this enterprise.

ELECTRIC RAILWAYS.

(Special Correspondence.)

DAVENPORT, IOWA.—Fred Cross is projecting the construction of an interurban to Monticello. C.

WATERLOO, IOWA.—The Waterloo, Cedar Falls & Northern has petitioned the council for permission to build a line on Commercial Street. C.

EVANSVILLE, IND.—The promoters of the Evansville, Mt. Carmel & Olney Traction Company report the sale of bonds sufficient to complete the road as far south as Lancaster, Ill. S.

MT CARMEL, ILL.—The City Council has granted a franchise for the use of the streets including a loop around the city park to the Evansville, Mt. Carmel, & Olney Traction Company. Z.

HIBBING, MINN.—The Mesaba Electric Railway Company is planning the construction of an electric trolley line, thirty-six miles long, to Gilbert. It is estimated that the cost will be $1,000,000.

JOURDANTON, TEX.—An interurban railway is to be built between Jourdanton and Pleasanton, six miles. C. S. Young is promoting the project. It will be operated either by gasoline motor or electricity. D.

NEWARK, N. J.—The Iowa Traction Company has been incorporated with a capital of $2,000,000 by George E. Wodehouse, Jefferson C. Mabry and Irving T. Hunter. The purpose of the Company is to construct railways.

MORRISTOWN, N. J.—Construction work has been officially started on the continuation of line of the Morris County Traction Company to Madison. The improvements also include the laying of a second track between this city and Morris Plains, a distance of two-and-one-half miles.

MONTGOMERY, ALA.—The Alabama Traction Company has been incorporated with $250,000 stock to establish a street railway system. C. G. Abercrombie, Montgomery, is president; Chas. F. Woodward, Wakefield, Mass., vice-president; and J. J. Flowers, Montgomery, secretary and treasurer of the new company. B.

NEWARK, O.—A new electric line has been planned from this city to Coshocton and Uhrichsville. The company will soon be incorporated. The survey for the route will parallel the Panhandle Railroad between the points just named. E. A. Nesbit of Pittsburg and A. E. Townsend of Doylestown are the promoters of the project.

HOUSTON, TEX.—The Bay Shore Rapid Transit Company has purchased 100,000 cross-ties and other material for its proposed interurban railway that is to be constructed between Houston and points on the bay shore. Grading will be started about November 25 and tracklaying will commence about February 15, it is stated. D.

WILLIAMSPORT, PA.—The contract was recently closed with the Pennsylvania Railroad for the electrification of the ten-and-one-half miles of road between Montandon and Mifflinsburg, Pa. The simplex system of the Simplex Surface Contact Company, Williamsport, Pa., is to be installed and work will be completed within five months.

CONCORD, N. C.—A formal deed has been filed here by which the Salisbury and Spencer Railway Company becomes the owner of the entire holdings of the Piedmont Carolina Railway Company, in Cabarrus County, in which this city is located, and also in Rowan County, in which Salisbury is located. The consideration was given at $125,000. L.

LAPORTE, IND.—The Air Line Traction Company, operating between this city and Westville, is out of commission owing to a breakdown in the power plant. The difficulty is of such a nature as to necessitate the purchase of a new 300-horsepower engine. The Company made an effort to purchase power from the Murdock plant, but failed to do so. S.

FINDLAY, O.—The project of constructing a trolley line from this city to Kenton and Columbus is again being revived. The line would connect with the Toledo, Bowling Green & Southern, making the shortest route between Toledo and the capital city. A party of Columbus capitalists recently viewed the proposed route. The same line has been proposed before. H.

SOUTH BEND, IND.—Limited interurban service to Peru, where connection to Indianapolis is made with the Indiana Union Traction Company's line, was begun November 10 through a traction agreement between the Northern Indiana and Winona interurban companies. Four cars each way will be operated daily between Michigan City, South Bend and Peru. S.

ATLANTA, GA.—The Southern Railway has just completed the installation of an interlocking and block signal tower at Austell, Ga., twenty miles from Atlanta, for the protection of this important junction of the lines from Chattanooga and Birmingham to Atlanta. It will be put in operation in time to take care of the winter train service which will be inaugurated November 27. B.

ANDERSON, IND.—The Indiana Union Traction Company has announced a generous increase in the wage of interurban train men. Beginning with January 1, the scale is to be twenty cents an hour for the first year of service and an increase of one cent

an hour up to the eighth year when the scale is twenty-seven cents. The city car men will likewise receive a corresponding increase. S.

STATESVILLE, N. C.—Announcement has been made that the Statesville Air Line Railroad Company will build at once a new line of road from Statesville to Yadkinville, the county seat of Yadkin County, a distance of twenty-five miles. The grading will be done and the rails laid by convict labor. The proposed road will run through a rich section of the country.

CLARINDA, IOWA.—A statement was recently made by C. A. Ross, president of the Engineering Construction and Securities Company, that the electric line between this place and Blanchard is well under way. The road will be of standard construction and is to be built at a cost of about $305,000, including equipment. Under favorable weather conditions the road will be in operation by January 15.

OAKLAND, CAL.—The Southern Pacific Railroad Company applied, a short time ago, for a franchise allowing the electrification of its Seventh Street line. It is expected that the Company will make immediate preparations to include the line in its general plan of establishing a modern electric railroad system in the east side cities. That work is now going forward rapidly in Alameda and Berkeley.

SOUTH BEND, IND.—The Chicago, South Bend & Northern Indiana Railway and the Winona Interurban Company have arranged for through service as far south as Peru. A close connection is made at Peru for Indianapolis over the Indiana Union Traction line. In the spring arrangements will be made to run trains through without change between Chicago and Indianapolis and possibly Louisville. S.

TEXARKANA, TEX.—A number of improvements are to be made on the lines of the Texarkana Electric Street Railway. Several streets are to be double tracked and an extension of two miles of tracks out to the glass factory will be made, work on which improvements, he said, will begin within a short time. Additional cars of the latest and most up-to-date- type were also purchased and will be here by December 1.

DEFIANCE, O.—At a meeting of the directors of the newly incorporated Defiance Interurban Electric Railway Company, the following officers were recently chosen: President, K. V. Haymaker; vice-president, C. E. Bennett; secretary and general manager, T. C. Jacks; treasurer, R. C. Holgate. The Company has a capital stock of $50,000 and will build an electric line from here to Ft. Wayne. It is well financed and most of the right of way has been secured. H.

HAGERSTOWN, MD.—A franchise has been granted to Maj. L. N. Downs and Hugh L. Kirby, of New York, whereby certain roads in the county may be used for a right of way for an electric railway between Hagerstown and Mercersburg, Pa., through Clearspring. A portion of the route from this city to Clearspring, a distance of twelve miles, is over the old National turnpike. The promoters state that the line will be constructed and in operation by July 1, 1911.

BIRMINGHAM, ALA.—Articles of incorporation are to be filed immediately for the Grandview Street Railway Company by E. W. Jordon, C. J. Phillips, W. M. Kane and associates, who have subscribed to the $100,000 stock. It is stated that actual work of construction will begin by December 1. The line is to be three and one-half miles long and will have no grade steeper than six per cent. The Board of Revenue, of Jefferson County, Ala., has been asked for rights over certain county roads. B.

HARVARD, ILL.—Nearly all the right-of-way from Walworth to Delavan, Wis., for the Harvard-Marengo Electric Railway has been completed. The line will go to Delavan first instead of Elkhorn as originally planned, it is said and the line to Elkhorn will be built later. Poles are being set between Harvard and Marengo and most of the work in connection with the approaches to the Northwestern viaduct in this city has been completed. It is expected to have cars running between Harvard and Marengo next spring. Z.

AIKEN, S. C.—Negotiations have been closed by the Harriman estate for the sale of the Augusta-Aiken Railway & Electric Company to the Equity Securities Company, organized by Redmond & Co., of New York. The consideration is understood to be approximately $3,000,000. The railway company owns and operates the street railway lines and the electric lighting plant in Augusta, and also owns the North Augusta Hotel Company, the North Augusta Land Company, and the interurban line from Augusta to this place.

ST. LOUIS, MO.—The St. Louis Car Company has, with its reorganization, gone into new hands, the president being John G. Beggs, of Milwaukee. The chairman of the board of directors is George J. Kobusch, other directors being David May, Moses Schoenberg and probaby Richard McCulloch. The deal made is conditional on the creditors who have unsecured claims aggregating $600,000 accepting preferred stock for them. This they have agreed to do, including the Westinghouse Company, the General Electric Company, the Keith Lumber Company, of Chicago, the Rattamond Building and Construction Company and the Union Electric Company. New capital has been provided to the amount of $850,000, and the new company starts off without any liabilities.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

SUTTON, NEB.—The Sutton Telephone Company is erecting a brick telephone exchange. C.

ONEONTA, N. Y.—The Rose Telephone Company has rebuilt its Grand Gorge-Roxbury line.

CROSBY, MINN.—The Deerwood-Aitkin Telephone Company will build a line to Ironton, Minn. C.

DILLON, MONT.—The Southern Montana Telephone Company is making extensive improvements along its lines. C.

ARMSTEAD, MONT.—The Gilmore & Pittsburg Telephone Company is making extensive improvements along its lines. C.

BUTTE, MONT.—The Rocky Mountain Bell Telephone Company will materially increase its mileage, and reconstruct the line to Deer Lodge. C.

WAUSAU, WIS.—The Marathon County Telephone Company will build about eighteen miles of new telephone lines next spring. It is estimated that about $2,000 will be expended. C.

NEWARK, N. J.—The new exchange of the New Jersey Telephone Company was recently put into operation, the circuits being cut over from the old exchange. This exchange is now the largest in the state.

KENDALLVILLE, IND.—The Kendallville Home Telephone Company has strung two additional circuits to Rome City to take care of the increased business from Fort Wayne. Two additional rural lines have also been built.

TOLEDO, O.—The plant of the Napoleon Home Telephone Company will be sold at public auction on December 12 at the Henry County court house. Ralph P. Brown, now receiver for the company, will conduct the sale.

TEMPLE TEX.—The Bell County Telephone Company has made extensive improvements in its property here and has expended a large amount of money on the exchange. Among other new apparatus a 2,000-drop switchboard has been added.

GRIFFIN, GA.—A. C. Leidy succeeds C. D. Freeman as manager of the local exchange of the Southern Bell Telephone Company in this town, Mr. Freeman having resigned his position a few days since. Mr. Leidy has assumed charge of the exchange in Griffin. L.

LERNA, ILL.—Officers were elected by the Lerna Mutual Telephone Company as follows: President, S. O. Beale, Trilla; vice-president, A. D. Stephenson, Lerna; secretary, R. G. Hall, Lerna; treasurer, J. M. Price, Janesville, and trustee, J. W. Brown, Trilla. Z.

HOLGATE, O.—The council of the municipality has ordered Receiver R. P. Brown to erect new poles here for the use of the Napoleon Home Telephone Company. Under a court order the receiver has begun the work. The present system of wires will be partly replaced by cables. H.

WAYCROSS, GA.—On account of reported dissatisfaction with existing service, it is stated that the Southern Bell Telephone Company will probably put in the common-battery system of telephones in this city, replacing the old magneto telephones in use for many years. It is also possible that a handsome new exchange building will be erected in Waycross. L.

ST. MARYS, O.—A total of 880 miles of copper wire, costing about $30,000, is being strung on the poles of the Lake Erie & Western. The work begins at Sandusky, O., and ends at Peoria, Ill., and includes the Indianapolis-Michigan City, and Northern Ohio divisions. The new wires are a part of a telephone system, to be used in conjunction with the telegraph. H.

WINTERS, CAL.—The Farmers' Mutual Telephone Company recently organized here has proved such a success that farmers who are members now purpose to incorporate and extend the lines of the Company. Three new lines are to be built to take in new territory, and it is planned to extend the service to Woodland, giving members of the Company connection with the long distance from there.

PHOENIX, ARIZ.—Announcement has been made of extensive improvements and extensions in the lines of the Consolidated Telephone, Telegraph & Electric Company. A new copper-metallic circuit is to be strung connecting Phoenix direct with Kelvin, Ray, Hayden, Winkelman and Christmas and will be in operation by February 1. In addition connection is to be made at Maricopa with the new trunk lines from Tucson to Los Angeles, which will be installed by December 1, thereby giving perfect connection with the coast city and all intermediate points.

CHIHUAHUA, MEX.—The Kellogg Switchboard & Supply Company has closed a contract for the complete new exchange equipment of the telephone system here. The new switchboard, which is to be magneto multiple, will have an ultimate capacity of 1,500 lines, the present equipment being 800 lines. There is to be double lamp supervision on the cord circuits and line and supervisory pilots in each position. In addition to the three sections of the magneto multiple switchboard, the equipment will include a main distributing frame, a combination chief operator's and toll switchboard desk, and a wire chief's desk.

ELECTRICAL SECURITIES.

As might have been expected, there was a reaction after the sharp rise prior to election, and prices were firm at the closing of the market on Saturday. Although the business was larger in volume than it has been for some time past, the trading was largely professional. Nearly two-thirds of the total business done was in Reading, Union Pacific and Steel. Trading in the latter, which was about one-third of the total, amounted to approximately $1,000,000. Trade developments were of a cheering nature. No immense orders for rails or equipment were recorded, but it was to be noted that there was an increase in rail buying and the placing of small orders from widely scattered roads for equipment showed the tendency of the great corporations.

At the annual meeting of the Electrical Securities Corporation the retiring directors wer re-elected.

The Chicago Telephone Company on November 1, had 232,153 telephones in Chicago, and 60,435 in the country, or a net gain of 3,775 for October. Its gain this year is 30,229, against 24,470 a year ago.

There has been listed on the Philadelphia Stock Exchange $2,716,700 common stock and $1,768,400 five per cent cumulative preferred stock of the Norfolk & Portsmouth Traction Company. The old capital stock of this company, amounting to $6,000,000, has been stricken from the list of the Exchange.

It is announced that the annual report of the Western Electric Company will probably cover thirteen months in order to make the fiscal year correspond hereafter with the calendar year. October returns of gross were, it is said forty per cent larger than one year ago. For the twelve months ended November 30 it is expected the gross sales will reach $61,000,000.

At the annual meeting of the Manhattan Railway Company Paul Morton was elected a director to fill the place of Dumont Clarke, deceased. Other directors and members of the executive committee were re-elected.

DIVIDENDS.

General Electric Company; quarterly dividend of two per cent; payable January 14.

National Carbon Company; special dividend of fifteen per cent, payable to stock of record October 28.

Philadelphia Electric Company; quarterly dividend of one and one-half per cent, payable December 15.

West Penn Traction Company; an initial semiannual dividend of one per cent of the common stock, payable December 15.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES ON THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

NEW YORK.

	Nov. 14.	Nov. 7.
Allis-Chalmers common	8½	9½
Allis-Chalmers preferred	31	34
Amalgamated Copper	68	71⅛
American Tel. & Cable	84	84
American Tel. & Tel.	141¼	142⅝
Brooklyn Rapid Transit	76¼	77⅝
General Electric	152½	154½
Interborough-Metropolitan common	20½	22¼
Interborough-Metropolitan preferred	55⅛	68⅜
Kings County Electric	123	123
Mackay Companies (Postal Telegraph and Cables) common	94¾	93
Mackay Companies (Postal Telegraph and Cables) preferred	73½	75
Manhattan Elevated	140	142½
Metropolitan Street Railway	*18	*18
New York & New Jersey Telephone	103	103
Pacific Tel. & Tel.	42½	41½
U. S. Steel common	77⅝	81
U. S. Steel preferred	117	118
Western Union	70½	72¼
Westinghouse common	69⅞	73½
Westinghouse preferred	120	120

*Last price quoted.

BOSTON.

	Nov. 14.	Nov. 7.
American Tel. & Tel.	141¼	142½
Edison Elec. Illuminating	279	272
General Electric	152½	154½
Massachusetts Electric common	20¼	20¼
Massachusetts Electric preferred	86½	85½
New England Telephone	136	136
Western Tel. & Tel. common	17	17
Western Tel. & Tel. preferred	90	90

PHILADELPHIA.

	Nov. 14.	Nov. 7.
American Railways	42¾	43
Electric Company of America	11⅝	11⅝
Electric Storage Battery common	47	48
Electric Storage Battery preferred	47	48
Philadelphia Electric	15⅝	15¼
Philadelphia Rapid Transit	16⅛	15⅝
Philadelphia Traction	81	81
Union Traction	39	39

CHICAGO.

	Nov. 14.	Nov. 7.
Chicago Railways, Series 1	75	76
Chicago Railways, Series 2	20	20½
Chicago Subway	???	5
Chicago Telephone	120	121
Commonwealth Edison	115	115⅝
Metropolitan Elevated common	20	20
Metropolitan Elevated preferred	65	65
National Carbon common	135	135
National Carbon preferred	118	118¾

PERSONAL MENTION.

WM. H. McKINLOCK, president Metropolitan Electrical Supply Company, Chicago, just returned from a two weeks' sojourn at Hot Springs, Ark.

J. C. LEWIS, former sales manager of the Kellogg Switchboard and Supply Company, Chicago, Ill., has again identified himself with the sales department of that company.

CHARLES RUBEL, formerly of the Connecticut Ignition department of the United Manufacturers, is now located at the factory of the Connecticut Telephone & Electric Company, of Meriden, Conn.

LOUIS E. FISHER of Danville, Ill. has assumed a position as vice-president and general manager of the street railway system of McAlester, Okla. and the interurban line between that city and Hartshorne.

ROBERT J. CHAMBERS, general manager of the Montgomery Light & Power Company, Montgomery, Ala., recently resigned from his office with that company. C. E. White has been appointed to take his place.

ASA HOSKINS has resigned his position as superintendent of transportation of the Jacksonville, Ill., Street Railway Company and will remove to a poultry farm in Missouri. His successor has not been named.

JOHN R. PETERSEN has suffered the loss of his wife, who has been afflicted with a tumor for some time. Her death resulted from an operation recently performed at St. Mark's Hospital, Salt Lake City, Utah.

WILLIAM H. SAVERY resigned his position as superintendent of the Western Massachusetts branch of the Springfield Street Railway on November 17. Mr. Savery has been in charge of the local street railway nine years and has been superintendent most of the time since the road was acquired by outside interests.

GEORGE ZOPF, director of Felten & Guilleaume Lahmayerwerke, Mülheim, Germany, wire and cable manufacturers, was a Chicago visitor last week. He is making a tour of investigation of electrical undertakings in this country, and was highly interested in the great central-station development of the Commonwealth Edison Company.

F. H. CLARK, general superintendent of motive power of the Chicago, Burlington & Quincy Railroad, delivered an address before the students and faculty of the College of Engineering of the University of Illinois on Thursday, November 3. His subject was "Problems of the Motive Power Department." Mr. Clark is a graduate of the University of Illinois with the class of 1890.

B. P. HANCOCK of Birmingham, Ala., was recently appointed division traffic superintendent of the Western Union Telegraph Company with headquarters in Atlanta. Mr. Hancock has been employed by the Postal Company in a similar capacity for a number of years and was located in Chicago, Memphis and Birmingham. His new territory embraces all states south of the Ohio River and east of the Mississippi River.

F. S. MINER, who has been connected with the plant department of the Southern Bell Telegraph and Telephone Company for two years, has resigned to accept a position in the engineering department of the Missouri and Kansas Telephone Company at Kansas City, Mo. Mr. Miner will take charge of the development work under the direction of the chief engineer of the Missouri and Kansas Telephone Company and the Bell Company of Missouri.

JAMES CLENDENIN ECKERT, second son of General Thomas T. Eckert, late president of the Western Union Telegraph Company, has begun proceedings to break his father's will, which gives to Thomas T. Eckert, Jr., the eldest son, the bulk of the estate. A clause in the will provides that any beneficiary who contests shall lose his bequest, and James C. Eckert runs the chance, if he is unsuccessful in the contest, of forfeiting a bequest of $50,000 cash and a life interest in $100,000.

R. K. MORSE, who has been with the Milwaukee office of the Pawling & Harnischfeger Company for a number of years, has been transferred to the Portland office, of which he is now in charge. Mr. Morse is not only thoroughly qualified from his past experience to take up the engineering problems put before him, but is also exceptionally well fitted to become the Company's sales representative. He will handle the complete line of cranes, hoists and lumber handling apparatus.

FRANK H. GALE, of the General Electric Company, presided at the banquet given by the Schenectady Press Club on Saturday evening, November 12, at the Edison Hotel. A number of visitors from out of town were present and there was a representative attendance of the leading citizens—about 130 in all. The topic of the evening was "Civic Unity" and over a dozen speakers participated in the discussion. William B. Efner, president of the club, made the opening address and then handed the meeting over to Mr. Gale, who most acceptably acted as toastmaster of a very successful and interesting occasion. Among the electrical men present were E. F. Peck, Horace E. Andrews, George E. Emmons, Fred R. Davis and N. R. Birge. H. S. Houston, vice-president of Doubleday, Page & Company, was one of the chief speakers.

OBITUARY.

EDWARD HANNING, who supervised the construction of the Kings County Elevated Railroad and many of the aqueducts of the Brooklyn Water Supply, died recently at his home in Brooklyn, in his seventy-sixth year. Two sons and three daughters survive him.

DANIEL T. NASH, who for sixteen years was connected with the Buffalo General Electric Company as its secretary and treasurer, died recently at his home in Buffalo. Mr. Nash had not enjoyed perfect health for the past two years and was compelled to give up active business interests a few months ago. His death however, was not expected.

DR. HENRY WURTZ, chemist and scientist, died at his home in Brooklyn on Nov. 8 in his eighty-third year. Dr. Wurtz, who was born at Easton, Pa., on June 5, 1828, was a graduate of Princeton University and also of the Massachusetts Institute of Technology, and he held the honorary degree of Ph. D. from Stevens Institute of Technology, Hoboken. He was the author of many scientific treatises, and was the first investigator to prove the existence of gold in sea water.

FRANCK Z. MAGUIRE, fifty years old, died last Saturday morning after a long illness at his home, in Baltimore, Md. He was an active member of Kane Lodge of Masons and the Lotus Club of New York. With offices in New York and London, he had a successful career in the financial world, and introduced several electrical patents abroad. Mr. Maguire is survived by a widow, Mrs. Maud B. Maguire, and a sister, Mrs. A. M. Hilliker, of Lanscotton mills in the section surrounding are using the company's

PROPOSALS.

VACUUM-CLEANING SYSTEM.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until December 5, for the installation of a vacuum-cleaning system in the United States post office and court house at Columbus, O., in accordance with drawing and specification, copies of which may be had at the office of the superintendent, Columbus, O., or at the Supervising Architect's office.

POST OFFICE, LEXINGTON, MO.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until December 19 for the construction, complete (including plumbing, gas-piping, heating apparatus, and electric conduits and wiring) of the United States post office at Lexington, Mo., in accordance with drawings and specification, copies of which may be obtained from the custodian of site at Lexington, Mo., or at the Supervising Architect's office.

POST OFFICE, ELLSWORTH, ME.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until December 7 for the extension, etc. (including plumbing, gas piping, heating apparatus, and electric conduits and wiring), of the United States post office and custom house at Ellsworth, Me., in accordance with the drawings and specifications, copies of which may be obtained from the custodian at Ellsworth, Me., or at the Supervising Architect's office.

POST OFFICE, LEAD, S. D.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until December 14 for the construction, complete (including plumbing, gas-piping, heating apparatus, electric conduits and wiring), of the United States post office at Lead, S. D., in accordance with the drawings and specification, copies of which may be obtained from the custodian of site at Lead, S. D., or at the Supervising Architect's office.

NAVY DEPARTMENT SUPPLIES.—The Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will open bids on naval supplies on the dates given below. Bidders interested therein should make early application for copies of the schedule, giving the schedule numbers desired. Schedules can be obtained from the Navy Pay Office nearest each navy yard. Bids will be asked on the following supplies:

Date	Material	Quantity	Place of Delivery	Schedule No.
Nov. 22	Cable, rubber-insulated	1,600 feet	Norfolk, Va.	3053
	Conductor, rat-tail	3,000 feet	Brooklyn, N. Y.	3056
	Ebonite	725 pounds	Washington, D. C.	3054
	Ventilating sets	15 sets	Brooklyn, N. Y.	3056
	Furnishing and installing generator sets	2	Newport, R. I.	3051

NEW PUBLICATIONS.

PRACTICAL ELECTRICITY AND ENGINEERING.—Under this title the Practical Electricity Publishing Company, Chicago, Ill., is publishing a practical electrical and miscellaneous engineering magazine, the first issue of which, under date of November, has recently been distributed. The publication will be issued principally in the interests of the practical, non-technical man, and the first issue contains a number of well-written articles dealing with elementary engineering subjects.

THE POLYTECHNIC ENGINEER.—The last issue of the Polytechnic Engineer, a book published annually by the undergraduates of the Polytechnic Institute of Brooklyn, contains a number of especially interesting articles. Among those of particular interest to electrical men may be mentioned: Negative Track Feeders, by Samuel Sheldon; Dr. Robinovith's Method of Resuscitation, by W. B. Kouwenhoven; The Impedance of Single-Phase Induction Motors, by Erich Hausmann; and Hyperbolic Functions in the Solution of Transmission-Line Problems, by George B. Wilkins.

RULES OF BOARD OF UNDERWRITERS.—The National Board of Fire Underwriters has issued the edition of 1910 of the following rule books: Construction and use of oxy-acetylene heating and welding apparatus; installation of sprinkler equipments; construction, installation and use of gasoline-vapor gas-lighting machines, lamps and systems; construction, installation and use of acetylene gas machines, and for the storage of calcium carbide; construction and installation of gravity tanks; construction of valves, indicator-posts and hydrants for mill-yard use.

CLASSIFICATION OF CONSTRUCTION AND OPERATING ACCOUNTS.—The National Electric Light Association has adopted a standard classification of construction and operating accounts for electric light and power companies and has recently issued, in book form, a complete report on this subject as compiled by the Committee on a Uniform System of Accounting. The report includes eight main divisions which are divided into fifty-seven sub-accounts. The main divisions are: Production; transmission; storage battery; distribution; utilization; commercial expense; new business and general expense. It is recommended by the Association that each company adopt the main eight divisions for two reasons, namely, that uniform or standardized accounts control the cost of operations and that comparisions of cost may be made with other companies having a similar standard classification of accounts. Those sub-divisions should be adopted which are best suited to the requirements of each individual company.

NEW INCORPORATIONS.

BAINBRIDGE, GA.—W. C. Cox and others have organized with $10,000 capital the Cox & Ball Supply Company, general machinery and electrical supplies of all kinds. B.

CLEVELAND, O.—The Electric Appraisal and Inspection Company has been incorporated with a capital of $10,000 by W. H. Hasselman, T. T. Quick, E. M. Fisher and J. J. Shipley.

CHICAGO, ILL.—The Vohr Sales Company has been incorporated with a capital of $2,500 to manufacture electrical machinery and supplies. The incorporators are Dwight B. Cleaver, George L. Cragg and Max I. Rosenberg.

TULSA, OKLA.—The Oklahoma Lightning Arrester and Electric Company has been incorporated with a capital stock of $10,000. The directors are George Stewart, Tulsa, A. B. Shawver, Grimes, Ia., and George M. King, Des Moines, Ia.

SPRINGFIELD, ILL.—The Millar Electric Company of Chicago has been incorporated with a capital stock of $10,000 to manufacture and deal in electrical devices and machinery. The incorporators are James R. Offield, Charles J. Schmidt and Frank R. Belknap. Z.

NEW YORK, N. Y.—Articles of incorporation have been filed by the United States Arc Light Company of New York city. The concern has a capital of $5,000 and will deal in arc lights. The directors are John J. Cokeley, Brooklyn; E. J. Forhan and H. P. Jones, of New York City. T.

DOVER, DEL.—The American Light, Heat & Power Company, with an authorized capital of $15,000,000, has been incorporated here. The company is to do a general utility business. The incorporators are: Warren N. Akers, William J. Maloney and Millard G. Taylor, all of Wilmington.

NEW YORK, N. Y.—The Kurtz-Poor Electrical Construction Company, of New York City, has been incorporated with a capital stock of $12,000. The concern will do a general electrical contracting and jobbing work. The directors are F. E. Gothier, N. E. Wiggins and E. Gresslee, all of New York City. T.

NEW YORK, N. Y.—The International Construction Company, of New York, to build electrical railways, erect telephone and telegraph lines, power supply works, etc., has been incorporated with a capital of $50,000. The directors are Max Miller, Alonzo G. McLaughlin and William Douglass, all of New York City. T.

NEW YORK, N. Y.—The Wilkinson Steam Engineering Company, of New York City, has filed articles of incorporation. The concern will deal in hardware and electrical equipment of every description and will also install plants for the generation of heat, light and power. The capital is $5,000 and the directors are James C. Hitchcock, Wilbur B. Wilkinson and Frederick Page, all of New York City. T.

TOLEDO, O.—The Perfect Fireless and Electric Cooker Company has been incorporated at Toledo, with a capital stock of $50,000. The incorporators are Luther D. Smith, W. A. Humphrey, C. F. Nighswander, M. C. Roth and E. R. Kirkendall. The concern will manufacture an electric fireless cooker at Fenton, Mich. It is expected to interest Toledo capital and a factory may be located in this city. H.

NEW ORLEANS, LA.—The charter of the Burke Electrical Company, Limited, capitalized at $15,000 has been filed at the Mortgage and Conveyance Office. The Company will conduct a general engineering and contracting business. Otto Maier, Thomas J. Burke and James H. Brady are the incorporators, with Otto Maier as president, Thomas J. Burke, vice-president and general manager, and James H. Brady, secretary and treasurer.

INDUSTRIAL ITEMS.

THE FOSTORIA GLASS SPECIALTY COMPANY, Fostoria, O., has distributed to the trade its decorative calendar for August.

H. W. JOHNS-MANVILLE COMPANY, New York, N. Y., has recently distributed its October and November number of the *J-M Roofing Salesman*.

THE LEEDS & NORTHRUP COMPANY, Philadelphia, Pa., has issued a list of the recent purchasers of Leeds & Northrup temperature-measuring apparatus.

H. T. PAISTE COMPANY, Philadelphia, Pa., has issued Number 79 of *Paistery*. The new Paiste socket and a number of other sockets and cut-outs are listed.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., describes the Westinghouse auxiliary-contactor equipments in its Folder 4186, which has just been issued.

THE ELECTRICAL ENGINEERS EQUIPMENT COMPANY, Chicago, Ill., is placing on the market an excellent line of power equipment specialties and is supplying the needs of some of the largest consumers in this line in the country.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., has issued a twenty-four-page booklet illustrating and describing a number of useful electrical novelties suitable for Christmas gifts for either children or grown-ups. The book is attractively prepared and well printed.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., describes in Bulletin No. 125, the installations of the "Chloride Accumulator" on the system of the Gulfport & Mississippi Coast Traction Company. Several views of the interior of the plant with the battery equipment are shown.

THE D. & W. FUSE COMPANY, Providence, R. I., illustrates and describes in its Bulletin No. 114 a line of subway boxes for low and high-tension service. The Bulletin not only covers equipment for enclosed fuses, but also shows various combinations for connecting subway lines where fuses are not required.

THE ELECTRO-MAGNETIC TOOL COMPANY, Chicago, Ill., has issued folders descriptive of its Model 5 electro-pneumatic hammer. This device, which was placed on the market a little more than a year ago, has elicited a great deal of favorable comment, and a number of testimonials and the names of many users are included in the folder.

THE NATIONAL INSULATOR COMPANY, Wellsburg, W. Va., has been incorporated with a capital of $600,000 to take over the plant of the Riverside Glass Company, and to equip the same for manufacturing glass insulators. The incorporators of the Company are W. F. Baird, J. E. Inman, C. F. Louthaime and others, of Pittsburg, Pa.

THE ROYSE ELECTRIC COMPANY, Indianapolis, Ind., announces that a complete reorganization has taken place, and that on November 4 the holdings of the old company were transferred to an entirely new management. The officers of the new company are: President, R. P. Oblinger; vice-president, H. E. Rasmussen; secretary, C. E. Kennedy; and treasurer, R. E. McGregor.

THE AMERICAN CONDUIT COMPANY, East Chicago, Ind., well known as the manufacturer of Bituminized fiber conduit for underground construction for electric light, telephone and railway-signal systems, has opened a Chicago office at 480 Monon Building, 324 Dearborn Street. The office will be in charge of F. C. Smith and H. E. Gifford, both of whom are well known in the conduit industry.

THE AMERICAN ARC LAMP COMPANY, Kalamazoo, Mich., recently issued Bulletin Number 44 on clusters and fittings for shop lighting. This bulletin replaces bulletins Number 40 and Number 42, and contains, together with descriptions, a number of illustrations of steel, porcelain-enameled units and clusters fitted with shock absorbers. Distribution curves for two of the clusters are given.

THE CUTTER COMPANY, Philadelphia, Pa., has issued calendars for the electrical trade for the year 1911. Each page of this calendar is imprinted with a circuit breaker of a different type, together with a brief description of it. Attention is called to the booklet on the subject of the protection of electric motors and electric motor driven machinery, which was sent out about a month ago.

ALLIS-CHALMERS COMPANY, Milwaukee, Wis., describes in a recent publication a number of uses of compressed air for industrial purposes. These uses include cleaning machinery in machine shops, power houses and factories, and also the application of the compressor sets in garages in connection with automobiles. Several illustrations of the uses are shown, and the machine and its arrangement are made prominent in these.

THE PAWLING & HARNISCHFEGER COMPANY, Milwaukee, Wis., announces that owing to the great increase of business on the Pacific Coast, and in order to serve better the interest of clients in that section, it has opened a branch office in the Washington Building, Portland, Oregon. This office is in charge of R. K. Morse, who for some years past has been a member of the engineering staff of the Company in the Milwaukee office.

ADOLPHUS BUSCH, PURCHASER OF AMERICAN DIESEL ENGINE COMPANY, St. Louis, has during the past two weeks made sales of his well known engine with the following: U. S. Naval Torpedo Station, Newport, R. I., electric power plant; Redwood Falls Light & Power Co., Redwood Falls, Minn.; Thibodaux, Louisiana, municipal plant; Rahr Brewing Co., Oshkosh, Wisconsin; Argentine War Ships, for port lighting sets, two on each ship.

TRUMBULL ELECTRIC MANUFACTURING COMPANY, Plainville, Conn., recently published the Thanksgiving number of *Trumbull Cheer*. Two important changes are noted in this issue, one being the revision of prices and schedules on slate-facing fuse box and fuse clips, and another mentioning the adding of splicing blocks of the Company's line of moulding branch blocks. The Company has also mailed a price list of Trumbull iron service bosses with or without switches.

PETTINGELL ANDREWS COMPANY, Boston, Mass., distributes in the November issue of *Juice* an interesting line of Christmas novelties. Such devices as miniature and candelabra incandescent lamps, toy engines, motors, medical batteries, etc., are included. Another feature of interest is the series of wiring tables devoted to dimensions, resistance and carrying capacity of copper wires, and there are also the usual pages devoted to new and seasonable goods.

THE TRIUMPH ICE MACHINE COMPANY, Cincinnati, O., has ready for distribution Bulletin No. 508, which calls attention to the practically unlimited field for refrigerating plants, the installation of which, through the central station, affords opportunity for increasing the day load. The bulletin contains illustrations and descriptions of recent installations of Triumph ice-making machinery and contains other interesting data which should prove of value to central stations desiring to build up a profitable day load.

THE SCHUG ELECTRIC MANUFACTURING COMPANY, Detroit, Mich. is distributing its attractive booklet dealing with the well known Schug isolated electric lighting plants. These lighting plants consist of a generator, completely equipped switch board and a storage battery and are particularly suitable for country and suburban residences, small hotels, theatres, etc. The plants are made in either portable or stationary types and in sizes ranging from generators of eighty watts capacity to 2,700 watts capacity.

THE PACKARD ELECTRIC COMPANY, Warren, O., in Catalog No. 10, which is ready for distribution, describes its complete line of transformers. Of especial interest are the data on the lighting and power transformers, station and high-voltage transformers, Mazda sign and house lighting transformers, welding transformers and switchboard current and potential transformers. An interesting feature of the publication and one which should make it valuable to central-station companies is the chapter containing central station testing directions for making test on transformers.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, of Pittsburg, Pa., has just issued its "Ad Book No. 20," offering newspaper copy to the central stations that are booming electrical appliances. The book contains a complete collection of very attractive and forceful advertisements covering the Westinghouse Company's lines of toaster stoves, disc stoves, irons, luminous radiators, air heaters, bell ringing transformers, and Cooper Hewitt rectifiers. The Company has also issued "Ad Book No. 21," containing advertisements of the Company's general-utility motor.

THE COLUMBIA METER COMPANY, Indianapolis, Ind., has mailed to its customers and other interested parties its Number 9 revised price list for insertion in Type "D" bulletin. Attention is called to the fact that these prices, while in effect from November 1, do not affect any customers until the expiration of their yearly contracts. The Company has also mailed descriptive matter regarding the Columbia rotating test meter for direct current. One of the notable features of this meter is its moderate price, as well as its accuracy. The instrument has an attachment for varying speed, the advantages of which are fully explained in the bulletin. This attachment is the Company's own invention and cannot be obtained on any other meter.

THE ALBERGER CONDENSER COMPANY, New York, N. Y., recently distributed to the trade three catalogs of Wainright heaters and accessories. Catalog Number 11 describes the Wainright improved expansion joint, and calls attention to the compactness of this device and the desirability of its use. A number of illustrations and tables on prices and weights are included. Catalog Number 13 describes the Wainright water heaters for hot water service systems. A double page illustration shows, in an attractive manner, the complete installation of the water heating system, as well as the water heater in detail. The Company's water heaters, expansion joints, heat extractors and air coolers are all described, together with numerous illustrations, in Catalog Number 14.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has issued several bulletins on the subject of lighting. One of these, Bulletin No. 4777, contains a large number of illustrations of the exterior and interior of buildings lighted by General Electric

Mazda and tantalum lamps. In addition to the illustrations there are data relative to the subject. Bulletin No. 4780 supersedes all previous bulletins on the Gem lamps. Several curves and tables are given. In Bulletin No. 4781 the series Mazda lamp is illustrated and considerable data proving the advantages possessed by this lamp over other incandescent lamps are included. The Bulletin illustrates also various styles of fixtures used in connection with street illumination, and contains considerable data of service to those interested in the subject. Folder B-3011, issued at the same time, describes decorative lighting outfits for Christmas trees.

DATES AHEAD.

Alabama Light and Traction Association. Annual meeting, Anniston, Ala., November 21-23.

American Physical Society. Next meeting, Chicago, Ill., November 26.

American Association for the Advancement of Science, and affiliated societies. Minneapolis, Minn., December 27-31.

Chicago Electric Show. Coliseum, Chicago, Ill., January 7-21.

Iowa Electrical Association. Annual meeting, Davenport, Iowa, April 19, 20 and 21.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) November 8, 1910.

974,774. CARBONATING-MACHINE. Louis Caul, Cleveland, Ohio. Filed Dec. 15, 1909. A pump for forcing water into a mixing receptacle is driven by a motor, the circuit for which is completed when a faucet handle is turned to discharge the carbonated water.

974,785. ELECTRIC INSECT-DESTROYER. William M. Frost, Eureka, Mont. Filed Feb. 5, 1910. Current is fed to parallel runs of wire through a tension device.

974,789. OZONIZER. David S. Henney, Newark, N. J. Filed Aug. 1, 1910. The apparatus for the production of ozone comprises two similarly shaped open-end glass cylinders of different diameters, each cylinder provided with openings in its wall near one end, each cylinder provided with a layer of foil, one of the cylinders being of a less size than the other and occupying an inverted position with relation to the other, the smaller within the larger, means for closing one end of the device, means for admitting air to the other end of the device, and an electrode within the inner vessel.

974,800. SIGNALING SYSTEM FOR RAILWAYS. James A. Jones, Ward, W. Va., assignor of one-half to William Quick, Ward, W. Va. Filed Nov. 9, 1908. An electric block signaling system.

974,802. SPARK-PLUG. Thomas C. Luce, Dalton, Mass., assignor to Luce Manufacturing Company, Dalton, Mass. Filed April 29, 1909. A spark plug comprises a body portion having two contact rods extending longitudinally therethrough, and generally parallel with each other, one of the rods being tiltable in relation to the other and each being turnable on its longitudinal axis.

974,812. PROCESS OF MAKING INCANDESCENT-ELECTRIC LAMP FILAMENTS. Herschel C. Parker, New York, N. Y., assignor to Parker-Clark Electric Company, New York, N. Y. Filed April 10, 1909. The process consists in flashing the filament in an atmosphere containing olefiant gas and the oxychloride of chromium.

974,824. SPARK PLUG. Elmer C. Rauch, Coeur d'Alene, Idaho. Filed Aug. 25, 1909. A guided, axially movable, spring-retracted electrode passes through a fixed annular electrode, the protruding end being bent over so as to make contact when an armature is attracted by an electromagnet which is connected at the other end of the device. De-energization of the magnet permits the spring to break the contact.

974,833. BRUSH FOR DYNAMO-ELECTRIC MACHINES AND THE LIKE. Edmund O. Schweitzer, Chicago, Ill. Filed March 5, 1909. The device comprises a brush having a chamber for lubricating compound, and a passage leading therefrom to the wearing surface, and spring means for forcing the lubricating compound from the chamber.

974,838. RECEIVING APPARATUS FOR ELECTROMAGNETIC WAVES. Edwin H. Smythe, Chicago, Ill. Filed July 24, 1906. An electromagnetic wave detector comprises an electrolyte, and a cathode and an anode having a very small area and a relatively large area, respectively, exposed to the electrolyte.

974,849. ELEVATOR-CONTROLLER. William D. Baldwin, New York, N. Y., assignor to Otis Elevator Company, Jersey City, N. J. Filed Aug. 11, 1906. A hydraulic retarding device is electrically controlled.

974,859. LIGHTNING-ARRESTER. William Butler, Lockport, N. Y. Filed June 13, 1908. Attachments for a horn arrester.

974,864. RAILWAY-SIGNAL. Frank L. Dodgson, Rochester, N. Y., assignor to General Railway Signal Company, Gates, N. Y. Original application filed March 27, 1903. Divided and this application filed April 23, 1904. A semaphore mechanism includes an electric clutch, etc.

974,866. AUTOMATIC TELEPHONE SYSTEM. Alfred H. Dyson, Chicago, Ill., assignor to Kellogg Switchboard & Supply Company. Filed Aug. 3, 1907. A locking circuit for each line serves, after initial operation, to continue a relay energized until its line is selected.

974,920. TROLLEY-CATCHER. James R. Ricketts, Longbeach, Cal., assignor to Los Angeles Trolley Catcher Company, Los Angeles, Cal. Filed Sept. 15, 1909. Dogs are slidably mounted radially in a reel and when the reel moves faster than the dogs can move by gravity, a stationary abutment is engaged by one of the dogs.

974,927. RECEIVING APPARATUS. Harry Shoemaker, Jersey City, N. J., assignor to International Telegraph Construction Company. Filed December 11, 1906. Renewed September 30, 1910. A wireless receiving apparatus comprises a receiving conductor or circuit, an electrochemical wave-responsive device associated therewith, a signal translating instrument, and means for impressing upon the wave-responsive device locally generated high-frequency oscillations.

974,930. ELECTRIC-LIGHT ATTACHMENT FOR GAS-LAMPS. Jason C. Stearns, Worcester, Mass. Filed January 31, 1910. An incandescent electric lamp is located with a parabolic reflector placed above an acetylene gas burner which also has another reflector behind it.

974,943. ILLUMINATED ANNOUNCEMENT AND DISPLAY SIGNAL. Frank W. Wood, Newport News, Va., assignor to Charles Cory & Son, New York, N. Y. Filed June 17, 1908. An illuminated electric signal device.

974,946. INCANDESCENT LAMP SOCKET. Reuben B. Benjamin, Chicago, Ill., assignor to Benjamin Electric Manufacturing Company, Chicago, Ill. Filed March 4, 1907. A plug lamp socket.

974,947. ELECTRIC-LAMP SOCKET. Reuben B. Benjamin, Chicago, Ill., assignor to Benjamin Electric Manufacturing Company, Chicago, Ill. Filed April 11, 1907. Similar to the preceding.

974,955. AUTOMATIC TELEPHONE SYSTEM. Alfred H. Dyson, Chicago, Ill., assignor, by mesne assignments, to Kellogg Switchboard & Supply Company. Original application filed November 13, 1906. Divided and this application filed November 23, 1907. A call-recorder is included.

974,963. ELECTRICAL PIANO. David J. Hauss, Aurora, Ind. Filed October 12, 1908. The mechanism comprises a casing and supporting member, a perforated sheet, a pair of sheet-feeding rollers rotatably supported upon the supporting member, a bar carried by the supporting member, a series of contact-fingers pivotally supported by the bar, a movable contact adapted to press the sheet into contact with the contact fingers, and a detachable bar carrying a series of spring fingers, the spring fingers resting upon the pivotal portion of the contact fingers in electrical contact with the contact fingers.

974,967. MAGNETO-ELECTRIC GENERATOR. Gottlob Honold, Stuttgart, Germany. Filed August 28, 1906. In combination with a dynamo-electric generator having means for producing a plurality of substantially equal maximum rates of chance of flux at alternately longer and shorter intervals, are ignition circuits arranged to be energized by said changes of flux, and two explosive engines having igniters within the ignition circuits and arranged in intersecting planes.

974,982. CATENARY OVERHEAD SYSTEM FOR ELECTRIC RAILWAYS. William Andrew McCallum, Cincinnati, Ohio. Filed May 13, 1909. The trolley wire is suspended under a supporting messenger wire by a continuous zigzag line hooked alternately to each.

974,985. RECEIVING APPARATUS. Frederick W. Midgley, Jersey City, N. J., assignor to International Telegraph Construction Company. Original application filed Jan. 26, 1906. Divided and this application filed February 25, 1909. Renewed September 30, 1910. There are a looped aerial conductor, capacity and inductance connected in this loop to form a closed circuit, the closed circuit forming a single path through all the inductance in series, a circuit in inductive relation with

the loop, and a wave-responsive device and a condenser serially connected in the associated circuit.

974,986. RECEIVING APPARATUS. Frederick W. Midgley, Jersey City, N. J., assignor to International Telegraph Construction Company. Filed March 5, 1906. Renewed September 30, 1910. Includes an adjustable tuning condenser.

975,018. SAFETY DEVICE FOR ELEVATORS. Claude G. Carpenter, Findlay, Ohio. Filed September 27, 1909. The elevator controlling mechanism is operated by an electrically controlled lever.

975,032. JUNCTION-BOX. Edwin T. Greenfield, Kiamesha, N. Y. Filed January 16, 1909. Has a wedge-operated screw closure.

975,034. ARC-LAMP. Paul Hanisch, Cologne-on-the-Rhine, Germany. Filed September 15, 1908. Has electrodes oppositely downwardly inclined and crossed above their lower ends, and automatic means permit movement of one of the electrodes automatically to increase the feed in accordance with increased current strength.

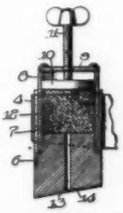
975,056. SPARK PLUG. William H. McNutt, New York, N. Y. Filed August 4, 1910. A spark plug comprises a multiperforated metal cap or thimble forming a sparking terminal, and a second electrode inclosed by and insulated from this terminal and having one end in spark-forming relationship to the edges of a relatively large orifice in the foraminous thimble, the gap therebetween being of less than flame-passing width, and the other orifices in the thimble also being so small as to prevent the passage of flame therethrough.

975,073. ELECTRICAL HAIR-SINGEING DEVICE. Ernest A. Roberts and Nels Laurence Johnson, Buhl, Minn. Filed January 20, 1910. A projecting wire loop connects with wires passing through the handle of the device.

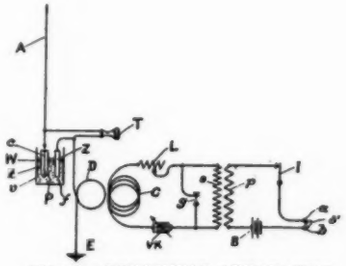
975,090. ELECTRICAL COUPLING AND SWITCH. Reinhold H. Wappler, New York, N. Y., assignor to American Cystoscope Makers, Inc., New York, N. Y. Filed May 25, 1910. Circularly arranged contacts are made and broken by rotary movement.

975,105. SEMI-AUTOMATIC TELEPHONE SYSTEM. Charles R. Austin, Longbeach, Cal. Filed April 30, 1907. A manually selected impulse transmitter automatically selects the subscriber's line.

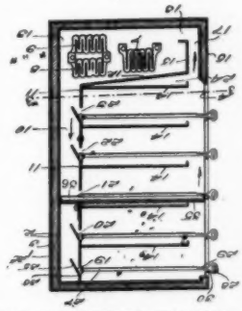
975,107. ELECTRIC BAKING-OVEN. James I. Ayer, Cambridge, and Horace B. Gale, Natick, Mass., assignors to Simplex Electric Heating Company, Cambridge, Mass. Filed November 11, 1909. An electrically heated oven inclosure has a baking chamber therein, a series of shelves spaced one above the other, a heating chamber below and separated from the baking chamber in the inclosure, electric heating elements in this heating chamber, a cool-air flue from one portion of the baking chamber opening into the lower part of the heating chamber, a hot-air flue extending upward from the upper portion of the heating chamber to the baking chamber, and means to regulate the temperature of the different shelves, consisting of air ports opening from the hot-air flue into the baking chamber over the respective shelves graduated in size so as to present less area for the admission of air at the upper levels than at the lower levels.



974,833.—CARBON BRUSH.



974,927.—RECEIVING APPARATUS



975,107.—ELECTRIC BAKING OVEN.

975,118. ELECTRICAL CONNECTOR. James J. Burns, Worcester, Mass., assignor to W. H. Leland & Co., Worcester, Mass. Filed November 23, 1908. The end of the wire of the conductor is held in a special clamping device.

975,126. NERNST-LAMP BODY. Otto Foell and Max Harris, Pittsburg, Pa., assignors, by mesne assignments, to Nernst Lamp Company, Pittsburg, Pa. Filed November 11, 1908. There are an insulating base portion with lamp terminals, and a ballast terminal and support strip mounted on the base, with ballast tube support sockets mounted on the strip, and ballast tubes mounted in the sockets, and a spring terminal secured to the base portion and contacting with the base of each ballast tube.

975,149. AUTOMATIC GAS-FEED FOR VACUUM-TUBES. Daniel McFarlan Moore, Newark, N. J., assignor to Moore Electrical Co., New York, N. Y. Filed November 8, 1906. The flow of gas into the tube is governed by an electromagnetic device, the action of which is controlled by a varying resistance which is regulated by the operative devices of an aneroid manometer.

975,165. FLAMING-ARC LAMP. Ralph Scott, Newark, N. J., assignor to Scott Electrical Company, New York, N. Y. Filed June 21, 1907. Downwardly convergent electrodes project through a cup connected to which by slender depending standards are arcuate iron cheeks or bars.

975,175. ALARM-SYSTEM. Walter J. St. Onge, Elyria, Ohio, assignor to The Dean Electric Company, Elyria, Ohio. Filed July 5, 1910. Removal of a key crushes a plate whereby a spring-pressed device is released and operates a switch to complete a circuit.

975,186. BURGLAR-ALARM SASH-LOCK. Morris Wheeler, Chicago, Ill. Filed April 26, 1909. A contact spring is held by the window-frame casing.

975,187. ELECTRICAL MECHANICAL PLAYER FOR MUSICAL INSTRUMENTS. John F. White, Pittsburg, Pa. Filed June 5, 1908. Rods are operated by solenoids.

975,261. SAFETY-FUSE. Swan J. Leveen and Edward A. Martin, Rock Island, Ill., assignors to Trio Manufacturing Company. Filed December 4, 1907. A continuous strip extends through the case, and independently and loosely mounted contact plates are arranged at the ends of the case to receive the ends of the strip therebetween.

975,277. PHOTOGRAPHIC METER-READER. Edward C. Pond, Petersburg, Va., assignor of one-half to Charles M. Patterson, White Plains, N. Y. Filed May 27, 1909. Renewed April 27, 1910. Includes an electric lamp, etc.

975,278. PHOTOGRAPHIC METER-READER. Edward C. Pond, Petersburg, Va., assignor of one-half to Charles M. Patterson, White Plains, N. Y. Filed April 30, 1910. Similar to the preceding.

975,302. TROLLEY. John Tari, East Columbus, Ohio. Filed August 14, 1909. A tandem wheel device with special guard features, etc.

975,338. TELEPHONE SYSTEM. Alfred H. Dyson, Chicago, Ill., assignor to Kellogg Switchboard & Supply Company. Filed December 4, 1906. A telephone exchange system comprises a plurality of telephone lines, a plurality of selecting switches, each having access to the lines, a master switch for selecting and starting idle selecting switches to establish connections with calling lines, means for restoring the master switch to a definite position after each selecting operation, means actuated during the operation of an actuated selecting switch to free the master switch for further use, and means for permitting the further operation of the master switch during the use of the actuated selecting switch only in response to an additional call.

975,346. TELEPHONE-DISINFECTOR. Benjamin Fulton Gardner, Chicago, Ill., assignor of one-half to S. R. Salinger, Chicago, Ill. Filed August 29, 1910. A telephone disinfector comprises electrodes fixed in and insulated by the dielectric material of a mouthpiece and suitable means in the signal circuit of a telephone to cause sparks to pass in the gap between the electrodes when the signal is operated.

975,358. ELECTRICAL HEATER AND MANNER OF MANUFACTURING SAME IN THE FORM OF TEXTILES. Michel Hefter, St. Petersburg, Russia, assignor to Leonard J. Lewery, New York, N. Y. Filed February 1, 1910. An electric heater consists of woven filaments, the major part of the filaments being of nonconducting material, while the balance are conductors of electricity adapted to be heated by the passage of an electric current along them, such conducting filaments being periodically brought to the surface of the fabric and floated over parts thereof.

975,359. KNITTED ELECTRIC HEATING-BODY. Michel Hefter, St. Petersburg, Russia, assignor to Leonard J. Lewery, New York, N. Y. Filed February 1, 1910. An electric heater consists of a fabric in which is incorporated a filament adapted

to conduct electricity and to be heated by the passage of a current thereof, the filament being incorporated into successive transverse sections of the fabric, such sections being separated by other transverse sections of the fabric not including the filament, and the filament being carried from one section into which it enters to the next along the edge of the fabric where it is left exposed.

975,386. METHOD OF PRODUCING METALLIC ARTICLES BY ELECTRODEPOSITION. Frank Iorns Gibbs, Birmingham, England. Filed February 23, 1909. A method of forming a rounded rim at an opening in a metal article consists in continuing the prepared surface of the glass or pottery ware model to a definite line on the other side so that when the metal is electrodeposited thereon a rim will be formed around the top of the vessel from which the model can be removed, and then filling in the rim with suitable material and making it solid.

PATENTS THAT HAVE EXPIRED.

Following is a list of the electrical patents (issued by the United States Patent Office) that expired November 14, 1910:

508,472. FENDER FOR ELECTRIC CARS, ETC. Caleb N. Homan, Lawrence, Mass.

508,482. ELECTRIC LAMP FOR BICYCLES. George Mayr, Brooklyn, N. Y.

508,493. METHOD OF REGULATING SELF-EXCITING ALTERNATE-CURRENT ELECTRIC GENERATORS. William Stanley, Jr., Barrington, Mass.

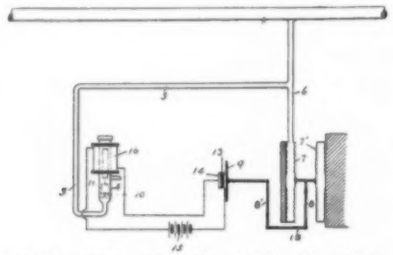
508,518. ELECTRIC DOOR-OPENER. Harry T. Johnson, New York, N. Y.

508,534. OVERHEAD SUPPORT FOR CONDUCTING-WIRES OF CLOTH-CUTTING MACHINES. Arthur K. Thyll, New York, N. Y.

508,538. ELECTRIC-RAILWAY TROLLEY. James Chase, Rochester, N. Y.

508,539. ELECTRIC-RAILWAY TROLLEY. Stephen D. Field, Stockbridge, Mass.

508,551. BATTERY-ELEMENT. William Mills, Elizabeth, N. J.



975,148.—GAS FEED FOR VACUUM TUBES.

508,559. ELECTRIC-LIGHTING SYSTEM. Theodore A. Willard, Norwalk, Conn.

508,563. COMBINED MESSENGER-CALL AND TELEPHONE. George E. Christie, Paterson, N. J.

508,578. CONDUIT FOR ELECTRIC RAILWAYS. Archibald J. Robertson, New York, N. Y.

508,613. UNDERGROUND ELECTRIC CONDUCTOR. John C. Henry, Westfield, N. J.

508,614. RECORDER OF SPEED OF DRIVEN SHAFTS. John C. Henry, Westfield, N. J.

508,615. ELECTRIC RAILWAY. John C. Henry, Westfield, N. J.

508,616. ELECTRIC CAR-LIGHTING SYSTEM. John C. Henry, Westfield, N. J.

508,620. FIELD-MAGNET COIL AND METHOD OF MANUFACTURING SAME. Joseph Johnson and Caryl D. Haskins, Lynn, Mass.

508,622. ELECTRIC-RAILWAY TROLLEY. Walter H. Knight, New York, N. Y.

508,623. STAND FOR TESTING ELECTRIC-ARC LAMPS. Edward R. Knowles, Middletown, Conn.

508,624. BRUSH-HOLDER FOR DYNAMO-ELECTRIC MACHINES. Edward R. Knowles, Middletown, Conn.

508,625. SWITCH BOX FOR CONTROLLING ELECTRIC CIRCUITS. Edward R. Knowles, Middletown, Conn., and Edwin H. Park, Millbury, Mass.

508,626. STAND FOR CONTROLLING ELECTRIC CIRCUITS. Edward R. Knowles, Middletown, Conn.

508,629. SAFETY CUT-OUT. Olof Offrell, Middletown, Conn.

508,630. FLUID-PRESSURE DEVICE FOR CONTROLLING ELECTRIC MOTORS. Horace F. Parshall, Lynn, Mass., and John W. Darley, Jr., Baltimore, Md.

508,632. ELECTRIC-ARC DISRUPTER. William R. Potter, Lynn, Mass.

508,633. ELECTRIC-RAILWAY MOTOR. Edward D. Priest, Lynn, Mass.

508,634. MOUNTING ARMATURES FOR DYNAMO-ELECTRIC MACHINES. Edward D. Priest, Lynn, Mass.

508,636. CONNECTOR FOR DYNAMO-ELECTRIC MACHINES. Henry G. Reist and Jonathan P. B. Fiske, Lynn, Mass.

508,637. ARMATURE-CORE. Henry G. Reist, Lynn, Mass.

508,638. MEANS FOR REGULATING MULTIPHASE CURRENTS. Edwin W. Rice, Jr., Lynn, Mass.

508,639. MACHINE FOR BORING OUT THE STANDARDS AND FIELD-MAGNETS OF DYNAMO-ELECTRIC MACHINES. John Riddell, Saugus, Mass.

508,640. DEVICE FOR BORING SPHERICAL CAVITIES. John Riddell, Saugus, Mass.

508,641. SWITCHBOARD FOR POWER-STATIONS. Albert L. Rohrer, Lynn, and George W. Mansfield, Melrose, Mass.

508,642. SEARCH-LIGHT. Albert L. Rohrer, Lynn, Mass.

508,643. CONNECTOR FOR ELECTRO-MAGNET COILS. Martin O. Southworth, Lynn, Mass.

508,644. BRANCH BLOCK FOR INCANDESCENT-LIGHTING CIRCUITS. Alfred Swan, Schenectady, N. Y.

508,646. SYSTEM OF ELECRICAL DISTRIBUTION. Elihu Thomson, Swampscott, Mass.

508,647. ELECRIC-LIGHTING SYSTEM. Elihu Thomson, Swampscott, Mass.

508,648. LIGHTNING-ARRESTER. Elihu Thomson, Swampscott, Mass.

508,649. PROTECTION FOR THE INSULATION OF DYNAMO-ELECTRIC MACHINES. Elihu Thomson, Swampscott, Mass.

508,650. ELECTRICAL TRANSFORMER. Elihu Thomson, Swampscott, Mass.

508,651. CONTACT APPARATUS. Elihu Thomson, Swampscott, Mass.

508,652. ELECTRIC CUT-OUT. Elihu Thomson, Swampscott, Mass.

508,653. INSULATING COMPOSITION. Elihu Thomson, Swampscott, Mass.

508,654. COOLING-TRANSFORMER. Elihu Thomson, Swampscott, Mass.

508,655. ELECTRIC TRANSFORMER. Elihu Thomson, Swampscott, Mass.

508,656. ELECTRIC-ARC LAMP. Elihu Thomson, Swampscott, Mass.

508,657. REACTIVE COIL. Elihu Thomson, Swampscott, Mass.

508,658. DYNAMO-ELECTRIC MACHINE OR MOTOR. Elihu Thomson, Swampscott, Mass.

508,659. LEADING-IN WIRE FOR INCANDESCENT LAMPS. Elihu Thomson, Swampscott, Mass.

508,660. DETECTOR FOR ELECTRIC-CURRENT METERS. Elihu Thomson, Swampscott, Mass.

508,661. ELECTRIC METER. Elihu Thomson, Swampscott, Mass.

508,662. INDICATING APPARATUS FOR ELECTRIC CIRCUITS. Elihu Thomson, Swampscott, Mass.

508,665. FUSE-PLUG. Herbert C. Wirt, Boston, Mass.

508,669. TROLLEY FOR ELECTRIC RAILWAYS. Norman C. Bassett, Lynn, Mass.

508,672. SWITCH FOR ELECTRIC RAILWAYS. Edward M. Bentley, New York, N. Y.

508,673. BRAKE APPARATUS FOR ELECTRICALLY-PROPELLED CARS. Francis O. Blackwell, New York, N. Y.

508,674. RHEOSTAT. John B. Blood, Lynn, Mass.

508,678. APPARATUS FOR TREATING FILAMENTS FOR INCANDESCENT ELECTRIC LAMPS. Henry D. Burnett, Lynn, and Samuel E. Doane, Swampscott, Mass.

508,680. ELECTRIC ELEVATOR. Arthur T. Chase, Cambridge, Mass.

508,687. CLEAT FOR ELECTRIC WIRING. Frederic A. Duggan, Trenton, N. J.

508,688. ELECTRICAL TRANSFORMER. Axel Ekstrom, Lynn, Mass.

508,691. ELECTRIC-ELEVATOR CONTROLLER. Jonathan P. B. Fiske, Lynn, Mass.

508,692. RHEOSTAT FOR CONTROLLING ELECTRICALLY-OPERATED DENTAL APPARATUS. Jonathan P. B. Fiske, Lynn, Mass.

508,721. ALTERNATING-CURRENT MOTOR. John F. Kelly and Cummings C. Chesney, Pittsfield, Mass.

508,743. ELECTRIC-RAILROAD TRACK CLEANER. Hugh O'Connor, Passaic, N. J.

508,805. ELECTRIC BRAKE FOR RAILWAYS. Armand De Bovet, Paris, France.

508,807. CONVERTER SYSTEM FOR ELECTRIC RAILWAYS. Charles S. Bradley, Yonkers, N. Y.

508,829. TELEPHONE TRANSMITTER. Eloy Noriega, Mexico, Mexico.

508,830. ELECTRIC TELEPHONE. Eloy Noriega, Mexico, Mexico.

508,838. ELECTRIC DISTRIBUTION. Edwin W. Rice Jr., Swampscott, Mass.

508,839. SYSTEM OF ELECTRIC DISTRIBUTION. Edwin W. Rice, Jr., Swampscott, Mass.

508,851. ELECTRIC BRAKE. Ernest B. Skinner, Ogden, Mich.

508,871. ELECTRICAL CONTACT-MAKING DEVICE. William F. Z. Desant, New York, N. Y.

508,880. ELECTRIC GENERATOR. Warren S. Hill, Hyde Park, Mass.

508,887. ELECTRICAL CONDENSER. John F. Kelly, Pittsfield, Mass.

508,898. SYSTEM OF ELECTRIC DISTRIBUTION. Walter S. Moody, Lynn, Mass.

11,386. MULTIPLE SWITCHBOARD. Milo G. Kellogg, Chicago, Ill.

11,387. MULTIPLE SWITCHBOARD. Milo G. Kellogg, Chicago, Ill.

11,388. MULTIPLE SWITCHBOARD. Milo G. Kellogg, Chicago, Ill.